TM 11-447

WAR DEPARTMENT TECHNICAL MANUAL

KEYERS TG-10-A, TG-10-B, TG-10-C, TG-10-D, TG-10-F, TG-10-G, TG-10-H, AND TG-10-J

WAR DEPARTMENT · 27 MARCH 1944

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This manual supersedes TM 11-447, Keyer TG-10-J (Automatic, 60 Cycles) and Keyers TG-10-A, TG-10-B, TG-10-C, TG-10-D, TG-10-F, 15 May 1943 and 25 August 1943, including Supplement No. 1, 15 August 1943.

KEYERS TG-10-A, TG-10-B, TG-10-C, TG-10-D, TG-10-F, TG-10-G, TG-10-H, AND TG-10-J

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Sig Fixed Rad Sta Co

(For explanation of symbols see FM 21–6.)

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Destruction Notice

WHY—To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—When ordered by your commander.

HOW—**1. Smash** Use sledges, axes, hand axes, pickaxes, hammers, crowbars, heavy tools, etc.

2. Cut Use axes, hand axes, machetes, etc.

3. Burn Use gasoline, kerosene, oil, flame throwers, incendiary grenades, etc.

4. Explosives Use firearms, grenades, TNT, etc.

5. Disposal Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

Use anything immediately available for destruction of this equipment.

WHAT—**1. Smash** All vacuum tubes, controls, dials, reels, transformers, and relays.

2. Cut All connecting wires, cables, etc.

3. Bend and/or break Jacks and plugs.

4. Burn All of the above equipment, training manuals, records, etc.

5. Bury or scatter Any or all of above pieces after wrecking them.

DESTROY EVERYTHING

SAFETY NOTICE

Since the voltages employed in this equipment are sufficiently high to endanger life, every reasonable precaution has been observed in design to safeguard the operating personnel. Care must be taken, however, to avoid bodily harm through contact with high-voltage plate circuits, or with the power plant output line.

This manual supersedes TM 11-447, Keyer TG-10-J (Automatic, 60 Cycles) and Keyers TG-10-A, TG-10-B, TG-10-C, TG-10-D, TG-10-F, 15 May 1943 and 25 August 1943, including Supplement No. 1, 15 August 1943.

Section I
Description

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1. GENERAL. a. Purpose. Keyer TG–10–(&) is an automatic unit for providing audible code practice signals from an inked-tape recording, and is included in and is a part of Code Practice Equipment EE–94–B, EE–95–B, and EE–96–B. The symbol (&) refers to all models of Keyer TG–10, that is, models A, B, C, D, F, G, H, and J. There is no model E or model I. For simplicity, models A, B, and C are referred to as Keyer TG–10–(1), and models D, F, G, H, and J are referred to as Keyer TG–10–(2). The output of Keyer TG–10–(&) is an audio frequency note of 800 cycles per second with sufficient power to supply a number of headsets, 500 to 1,000 if necessary, or practice tables directly. The keyer, a self-contained unit, is ready for operation when connected to power mains and headsets directly or through practice tables.

b. External keying. Keyer TG–10–(&) may also be operated by an external telegraph key, either manual or automatic, supplying 500 to 1,000 headsets with an 800-cycle note. When an external key is used, the tape mechanism should not be operated.

c. Ink recording. Except for Keyer TG–10–A, Keyer TG–10–(&) is equipped with suitable guide and pressure rollers, which permit its use with any one of several types of ink recorders when none is furnished with the tape-pulling mechanism (par. 9d).

2. DIFFERENCES. All models of Keyer TG–10–(&) are mechanically and electrically similar. Differences are explained below and elsewhere in this manual.

a. Keyers TG–10–B and TG–10–C are identical.

b. Keyers TG–10–A, TG–10–B, and TG–10–C are identical except that the power and filament transformers and the motor of Keyer TG–10–A are wound for 25-cycle instead of 60-cycle current.

c. Keyer TG–10–(2) differs from other models in the following respects:

(1) The motor, cone, driving assembly, and related parts are mounted differently.
(2) The speed indicator assembly is different.

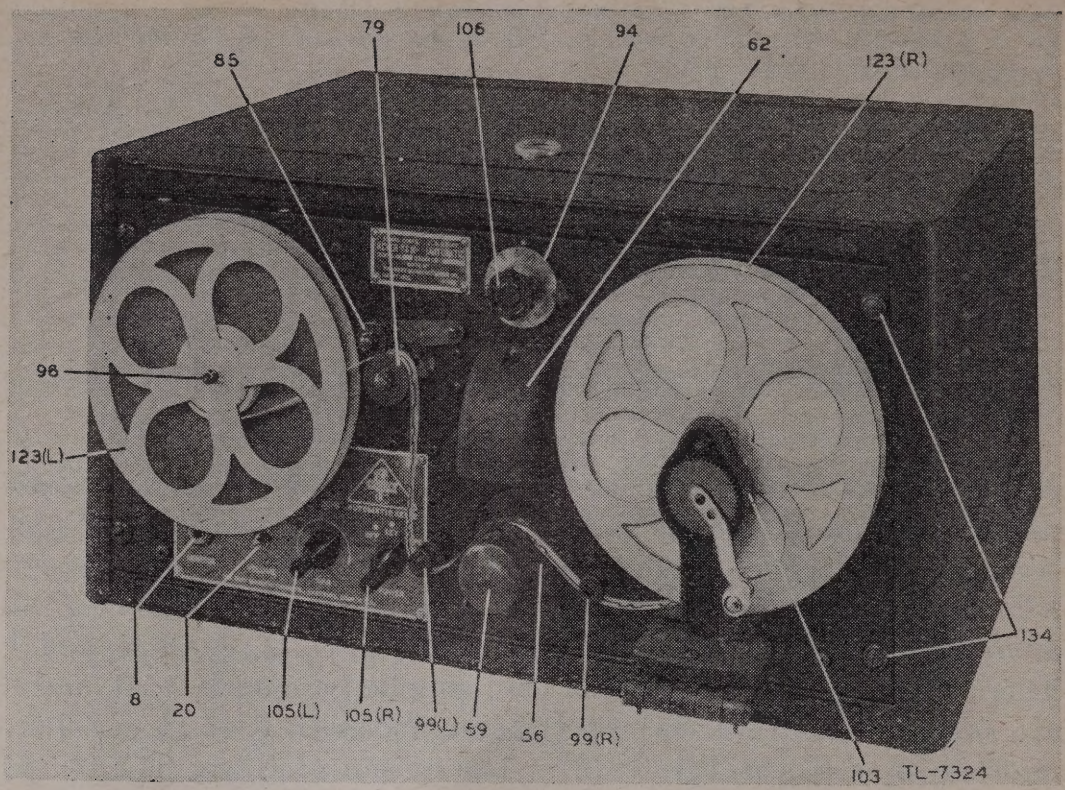

FIGURE 1. *Keyer TG–10–(1), front view.*

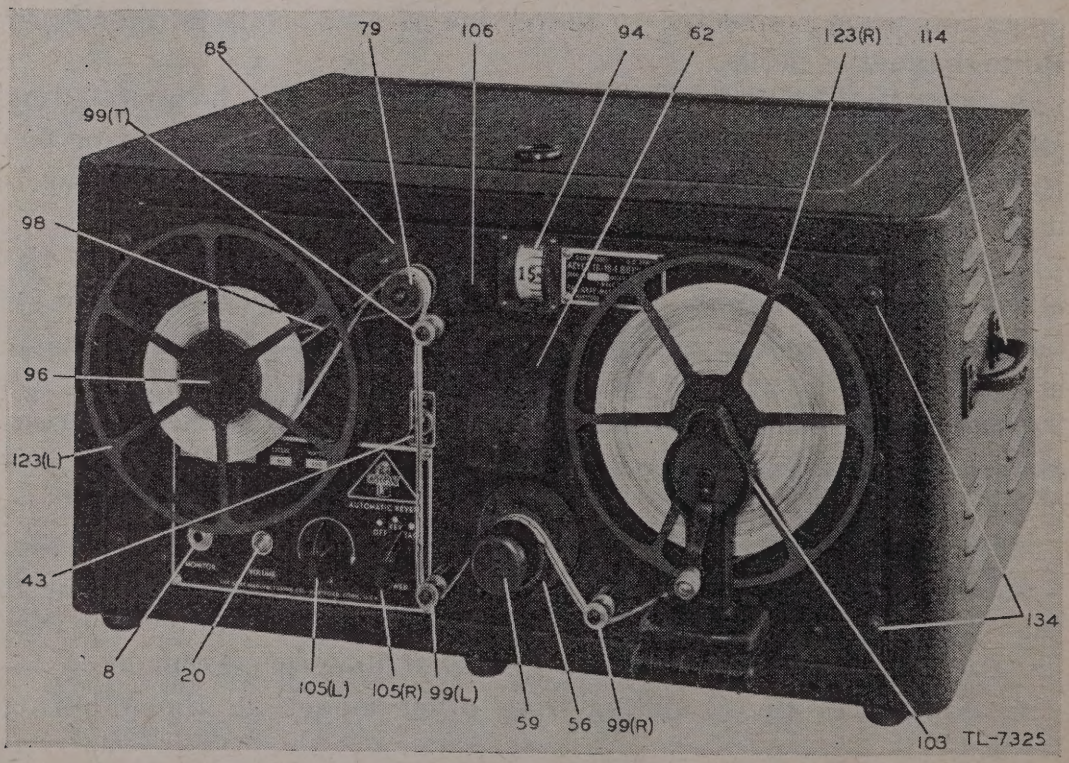

FIGURE 2. *Keyer TG–10–(2), front view.*

(3) A dial lamp has been added.
(4) A slotted, screw-driver bias adjustment (26)* (fig. 4) has been added, giving two bias adjustments (26) and (40) (fig. 6).
(5) A motor switch (43) (fig. 2) has been added.
(6) An additional roller (99 (T)) (fig. 2) has been added.
(7) Resistor (39) (figs. 8 and 11) (4,000-ohm) replaces resistor (27–1) (figs. 7 and 11) (4,700-ohm).
(8) Resistor (27) (figs. 8 and 11) (2,500-ohm) replaces resistor (27–2) (figs. 7 and 11) (4,700-ohm).
(9) Resistor (40) (fig. 8) (200-ohm) has been added.

d. Resistors (36–1) (250-ohm) and (36–2) (250-ohm) have been added (fig. 8) on Keyer TG–10–J.

3. COMPONENTS, WEIGHTS, AND DIMENSIONS. a. Components, weights, and dimensions of Keyer TG–10–(&) are listed below:

Quantity	Name of part	Maximum over-all dimensions including projections			
		Height (inches)	Width (inches)	Depth (inches)	Weight (pounds)
1	Keyer TG–10–(&):				
	Keyer TG–10–A	10¾	21⅝	18½	70
	Keyer TG–10–B, C	10¾	21⅝	18½	61
	Keyer TG–10–(2)	11	24	18½	63
1	Set vacuum tubes:				
		Signal Corps type	*Commercial type*		
	2 tubes	VT–96	6N7		
	2 tubes	VT–115	6L6		
	2 tubes	VT–116	6SJ7		
	1 tube	VT–244	5U4–G		
	1 tube	VT–252	923		
2	Tapes, inked paper				
3	Reels, take-up				

NOTE: Accessories required are a monitoring headset and an external key.

b. Keyer TG–10–(&) is mounted in a cabinet, as shown in figures 1 and 2.

c. Removed from the cabinet, the keyer fits a standard 19-inch relay rack. The height of the panel is 8¾ inches. Keyer TG–10–(&), except Keyer TG–10–A, weighs 40 pounds without its cabinet. Keyer TG–10–A, without the cabinet, weighs 47 pounds.

*Numbers in parentheses refer to parts of this equipment as shown in photographs and diagrams throughout this manual.

4. POWER SUPPLY. Keyer TG–10–(&), except Keyer TG–10–A, operates on 115-volt, 60-cycle alternating current. A voltage variation within the range of 95 to 120 volts will not substantially affect the operation of the instrument. Keyer TG–10–A operates on 110-volt, 25-cycle alternating current.

5. CONTROLS. Controls, adjustments, switches, and other parts on the front panel are—

a. A *monitor* jack (8) (figs. 1 and 2) for plugging in a headset when adjusting the bias and phototube aperture, or for monitoring when keyer is in operation.

b. A *volume* control (20) (figs. 1 and 2) with slotted shaft for screw driver adjustment.

c. A *bias* L control (105 (L)) (figs. 1 and 2), to provide a fine adjustment of bias after bias control (26) (fig. 4) on the chassis has been adjusted.

d. A *power-off-key-tape* switch (105 (R)) (figs. 1 and 2).

e. Phototube and aperture adjustment (59) (figs. 1 and 2).

f. Phototube housing (56) (figs. 1 and 2).

g. Tape-rewind mechanism (103) (figs. 1 and 2).

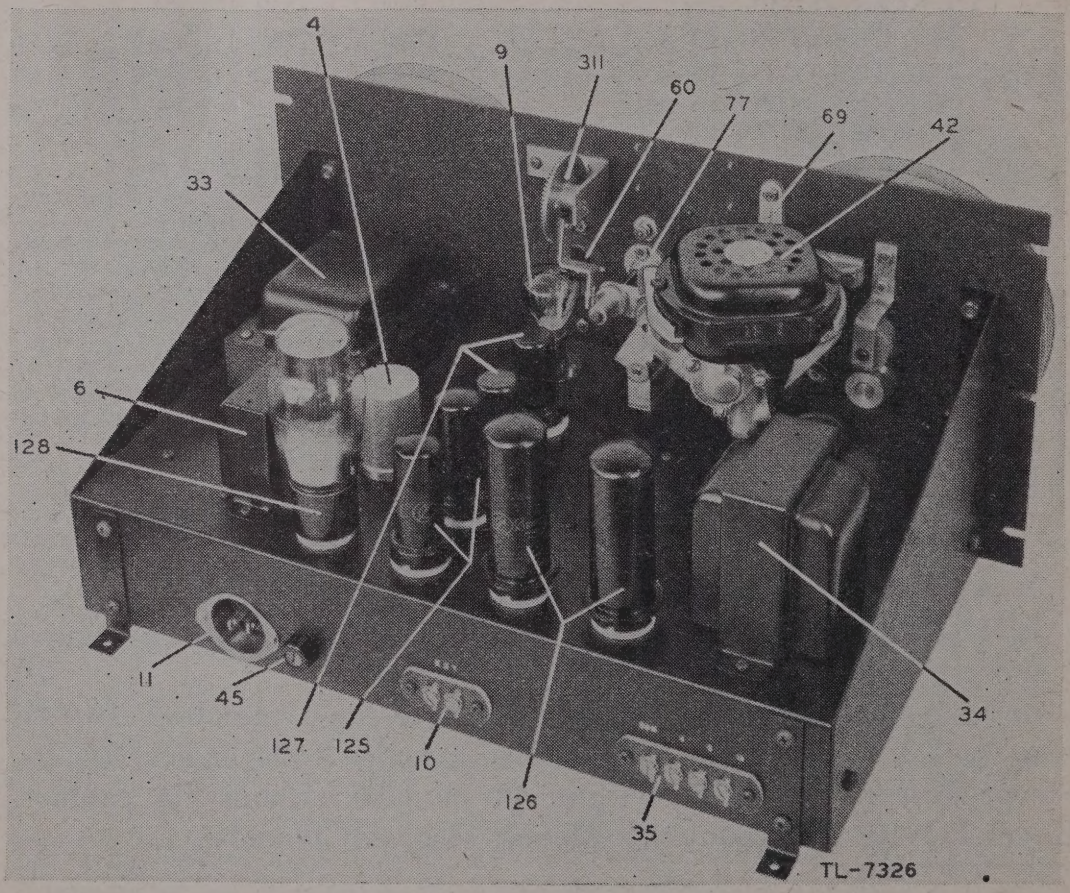

FIGURE 3. *Keyer TG–10–(1), rear view, cabinet removed.*

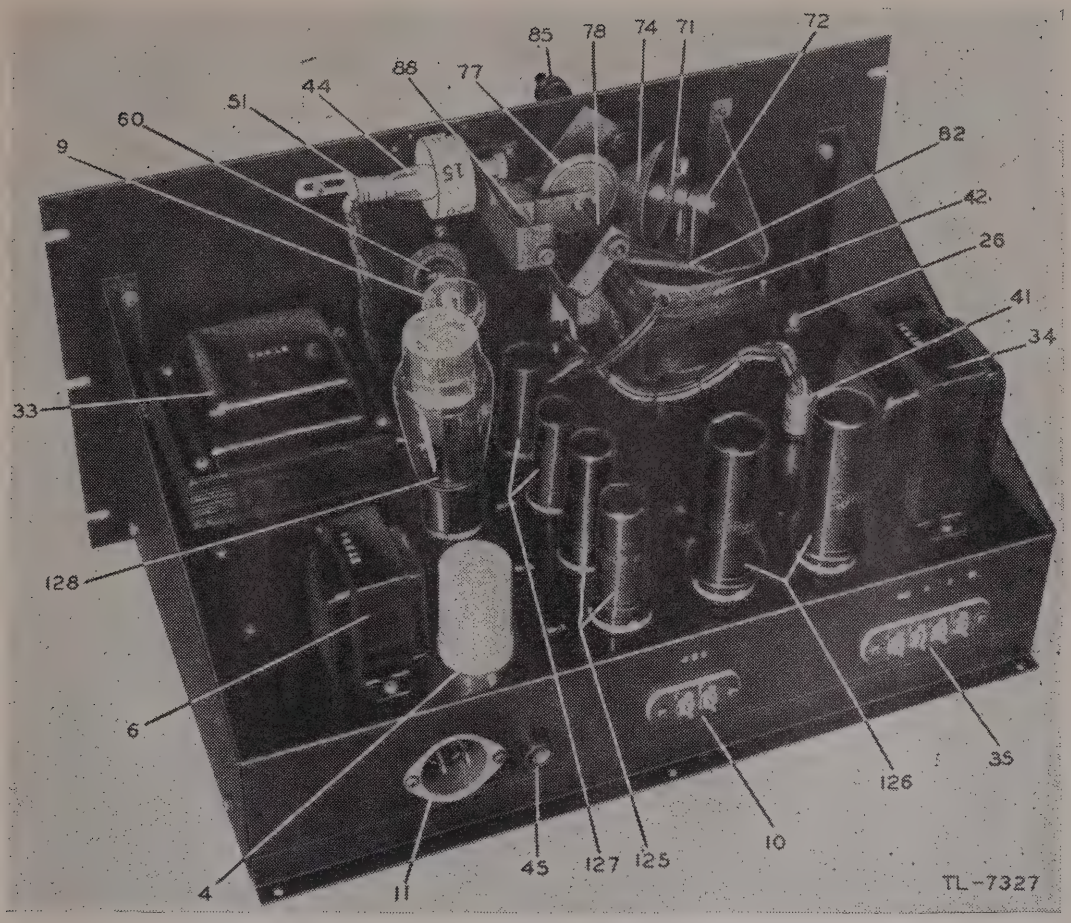

FIGURE 4. *Keyer TG–10–(2), rear view, cabinet removed.*

h. Tape reels (123 (R)) and (123 (L)) (figs. 1 and 2).
i. Mirror housing (62) (figs. 1 and 2).
j. Tape-speed indicator dial (94) (figs. 1 and 2).
k. Tape-speed indicator control (106) (figs. 1 and 2).
l. Tape-puller roller (79) (figs. 1 and 2).
m. Tape-content pressure roller (85) (figs. 1 and 2).
n. Take-up reel drive belt (98) (figs. 1 and 2).
o. Take-up reel shaft assembly (96) (figs. 1 and 2).
p. Motor OFF-ON switch (43) (fig. 2) (on Keyer TG–10–(2) only).
q. Tape guide rollers (99 (L)) and (99 (R)) (figs. 1 and 2).
r. Tape guide roller (99 (T)) (fig. 2).

Section II

Installation and Operation

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6. INITIAL PROCEDURE. a. Unpacking. Keyer TG–10–(&) is packed in an individual carton. The unit may be removed by opening the carton at the top, carefully removing the cardboard blocking pieces from the front and sides, and lifting the cabinet from the carton.

b. Tubes. A set of vacuum tubes, exclusive of the photoelectric cell and exciter lamp, is in a separate cardboard container issued with the keyer and marked "Tube Set for Keyer TG–10–(&)." Inside the carton are seven vacuum tubes, each separately packed and marked with its tube number. A list of these tubes is given in paragraph 3a. After the tubes have been unpacked, insert them in the proper sockets on the chassis. The keyer is shipped with the photoelectric cell and exciter lamp already installed.

7. INSTALLATION. a. Selection of output. Three output impedances are provided at the output terminal board (35) (figs. 3 and 4) on the rear of the chassis. Impedance of 4, 8, or 15 ohms may be selected by connecting to the common terminal and the terminal with the desired impedance. The most suitable matching impedance may be determined from the number of headsets to be connected to the keyer and the impedance of each. If many headsets are used, the 4-ohm output terminal is most suitable. If only a few headsets are connected, the 15-ohm output terminal is preferable. Try all output terminals and use the one giving most satisfactory operation. The power used by one headset is considered about 5 milliwatts.

b. Wiring. (1) TABLE MOUNTING. If the keyer is to be operated from a table or bench, place it in position and run a pair of leads from the output terminals (35) (figs. 3 and 4) to the volume-control board (sometimes called a patching board). (Information on wiring of the volume-control board may be found in TM 11–432.) Plug the power cord into the receptacle (11) (figs. 3 and 4) on the rear of the chassis, and into a convenient power outlet.

(2) RACK MOUNTING. If several keyers are to be mounted together on a standard relay rack, remove the unit from the cabinet by first removing the screws (134) (figs. 1 and 2) on the ends of the

panel, and then the three screws holding the rear of the chassis to the bottom of the cabinet. The panel and chassis are fastened together so that the keyer can be mounted, using the panel screws, to the relay rack. Install external wiring as described in (1) above.

8. PREPARATION FOR USE. a. Adjustment of light gate. The removable cover (59) (figs. 1 and 2), inclosing the phototube, contains a small aperture or opening, through which light passes. The position of the aperture under the tape is adjusted by sliding the cover in or out, and locking it in position with the knurled nut (165) (figs. 5 and 6) below it. To adjust the position of this aperture, fold the tape at a point corresponding to a space between dots and dashes, which as a rule is at the point where the inked line is off the center of the tape. By placing the end of the tape next to the light aperture, the cover can be manipulated until the hole is opposite the middle of the inked line.

b. Threading. When the rewind mechanism (103) (figs. 1 and 2) is pulled forward, it will allow a full reel of tape (123 (R)) (figs. 1 and 2) to be put in place. (Wind the reel so that the inked side of the tape faces the hub of the reel.) Hole the reel, with the square driving hole facing the operator and the free end of the tape suspended at the operator's right side. Snap the reel in place over the ball catch, with the square driving hole toward the crank, and return the rewind mechanism to its original position with the reel vertical. Disengage the pressure roller (85) (figs. 1 and 2) from the puller roller (79) (figs. 1 and 2) and pass the tape, inked side up, under guide roller (99 (R)) (figs. 1 and 2), over the light gate (59) (figs. 1 and 2), under guide roller (99 (L)) (figs. 1 and 2), to the left of guide roller (99(T)) (fig. 2) (not on Keyer TG–10–(1)) and over the puller roller (79) (figs. 1 and 2). Insert the end of the tape in one of the slots in the hub of the take-up reel (123 (L)) (figs. 1 and 2) and, turning the wheel by hand to the right, wind on a few layers of tape.

9. OPERATION. a. Tape keying. (1) START. Turn the rotary switch knob (105 (R)) (figs. 1 and 2) to TAPE, to start the motor and amplifier. Allow the set to warm up for a few minutes. To engage the drive, lower the pressure roller (85) (figs. 1 and 2). The tape will then be forced against the puller (79) (figs. 1 and 2), and the keyer will reproduce the signal recorded on the tape.

(2) BIAS. With the tape running, plug a headset into the MONITOR jack (8) (figs. 1 and 2). With the BIAS knob (105 (L)) (figs. 1 and 2) vertical, use a screw driver to rotate the bias control (26) (fig. 4) (located on the chassis to the left of motor (42) (fig. 4)) on Keyer TG–10–(2) until a clear signal is heard. (On Keyer TG–10–(1) rotate the bias control knob (105 (L)) (fig. 1).) If the control is turned too

far to the left, no signal will be heard, or if it is turned too far to the right a steady signal will result. The correct position is between these extremes. The adjustment should not be critical. If the bias control requires a very close setting, recheck the adjustment of the light gate. Since the line voltage supplying the keyer changes, it may be necessary to reset the bias control. The BIAS knob (105 (L)) (figs. 1 and 2) provides a fine adjustment of the bias, and is used in normal operation of the keyer, after the bias control (26) (fig. 4) on the chassis has been properly adjusted.

(3) VOLUME. The volume of the signal delivered to the practice tables may be varied by the screw driver adjustment (20) (figs. 1 and 2) marked VOLUME. Turning to the right increases the volume.

(4) TAPE SPEED. The speed control knob (106) (figs. 1 and 2) controls the rate of speed of the tape and the speed of the transmission. Before turning the speed control knob, *disengage the tape feed by lifting the pressure roller (85) (figs. 1 and 2)*. The indicator dial (94) (figs. 1 and 2) is calibrated in feet per minute to indicate the linear speed of the tape.

NOTE.—It may be necessary to improvise in order to keep the tape taut while the unit is in operation. One way is to place a paper clip under the top panel screw (figs. 1 and 2) and bending it so it acts as a brake on the reel (123 (R)) (figs. 1 and 2).

(5) MOTOR SWITCH. On Keyer TG–10–(2), when using the keyer as a tape puller with a separate inker, the motor switch (43) (fig. 2) will permit turning the motor on regardless of the position of the rotary switch (105 (R)) (fig. 2).

b. Rewinding. To return the tape to the magazine reel (123 (R)) (figs. 1 and 2)—

(1) Disengage the drive by moving the pressure roller (85) (figs. 1 and 2) upward and away from the puller roller (79) (figs. 1 and 2).

(2) Remove the tape from the puller roller so that it feeds from the reel (123 (L)) (figs. 1 and 2) to the guide roller (99 (L)) (figs. 1 and 2) under the phototube housing and directly to the guide roller (99 (R)) (figs. 1 and 2).

(3) To return the tape, turn the handle of the rewind mechanism to the right.

NOTE.—Do not rewind the tape too fast, or it may be torn and the rewinding gear damaged. *Keep the tape taut.*

c. External keying. To transmit the signal of a manually operated key to the practice tables, turn the rotary switch knob (105(R)) (figs. 1 and 2) to KEY (connected to the KEY terminals (10) (figs. 3 and 4) on the rear of the chassis). With manual keying the bias

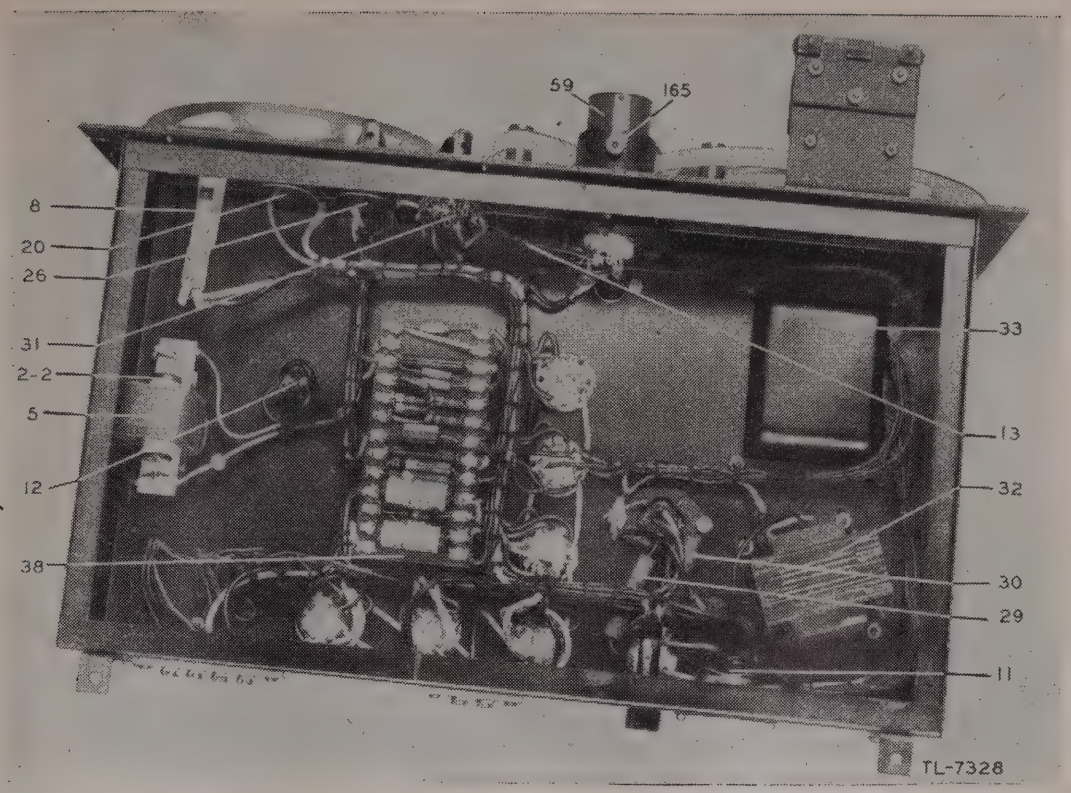

FIGURE 5. *Keyer TG–10–(1), chassis, underside.*

control is out of the circuit, but the volume control functions exactly as it does with tape keying.

d. Tape pulling for ink recorder. To operate the puller mechanism with a separate inker, first locate the inker to the right of the keyer. Remove the magazine reel (123(R)) (figs. 1 and 2). Thread the tape on the inker reel under the guide roller (99(R)) (figs. 1 and 2), under the phototube housing (*over* the phototube housing in Keyer TG–10–(1)), *under* the guide roller (99(L)) (figs. 1 and 2), to the left of the guide roller (99(T)) (figs. 1 and 2), and over the puller roller (79) (figs. 1 and 2). The part of the rollers coming in contact with the top, or inked side of the tape, have their centers recessed and will not smear freshly inked characters. The tape may fall freely into a basket on the floor. When using Keyer TG–10–(2) with an ink recorder, turn the motor switch (43) (fig. 2) ON, so that the motor is operated independently of the rotary switch knob (105(R)) (fig. 2). If the ink recorder requires an oscillator to actuate the ink stylus, turn the rotary switch knob (105(R)) (fig. 2) to KEY, connect a manually operated key to the KEY terminals (10) (figs. 3 and 4), and connect the ink recorder signal input terminals to the output terminals (35) (figs. 3 and 4) of the keyer.

e. Pressure roller. When the keyer is not in use, set the pressure roller (85) (figs. 1 and 2) *up* with the feed disengaged, to avoid damaging the drive roller (79) (figs. 1 and 2).

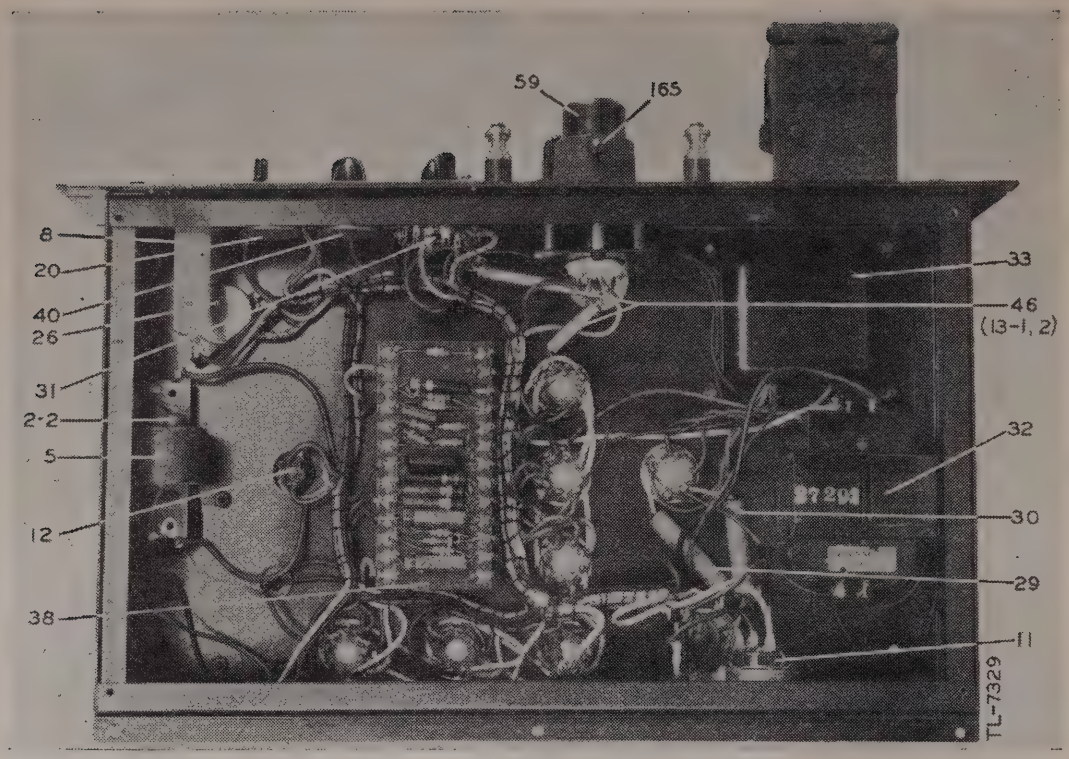

FIGURE 6. *Keyer TG–10–(2), chassis, underside.*

10. ADJUSTMENTS FOR FIELD UPKEEP. a. Tubes. A possible source of trouble is a defective tube. Check all tubes every 500 hours of operation (par. 16f).

b. Photoelectric cell. Should it become necessary to replace the photoelectric cell, refer to paragraph 16g.

c. Exciter lamp. The exciter lamp (9) (figs. 3 and 4) contains two filaments, only one of which is used at a time. If the lamp fails to light when the rotary switch is at TAPE, see paragraph 16h.

d. Fuse. The keyer is shipped with a fuse in place in its holder (45) (figs. 3 and 4) on the rear of the chassis. If the keyer fails to operate when turned on, check the fuse. If burned out, replace fuse as outlined in paragraph 16i.

e. Operator maintenance. Preventive maintenance performed by the operator is discussed in paragraph 15.

Section III

Functioning of Parts

11. POWER SWITCH. The power switch (31) (figs. 5 and 6) is a three-position rotary switch with the positions marked OFF, KEY, and TAPE. At OFF the entire unit does not operate. The puller motor of Keyer TG–10–(2) is turned on and off independently by a motor switch (43) (fig. 2) when used as a tape puller. At KEY, the oscillator-amplifier section is turned on and the hand key controls the tone output (par. 9c); both the puller motor (42) (figs. 3 and 4) and the exciter lamp (9) (figs. 3 and 4) are inoperative. At TAPE, the motor and the lamp are turned on, in addition to the oscillator-amplifier, and the unit functions as a full automatic tape keyer.

12. VOLTAGE AMPLIFIER (figs. 7 and 8). **a.** When the main switch is set at TAPE, light falling on Tube VT–252 (phototube V_1) causes the current to flow through its plate resistors, making the voltage positive at the upper end of resistor (13–1) and negative at the lower end of resistor (13–2) (figs. 7 and 8). The voltage across the bias controls developed by the rectifier bleeder current causes a positive potential at the cathode of Tube VT–116 (V_2) with respect to the lower end of resistor (13–2). From the cathode of tube (V_2) to its grid, the bias voltage is from plus to minus, and the phototube load voltage is from minus to plus. These two voltages are in opposition; and the difference furnishes the trigger voltage, so that with a greater light intensity, the grid voltage is more positive with respect to the cathode, and with less light intensity, it is more negative.

b. Resistor (15–1) is the plate load for (V_2) as well as the grid resistor for Tube VT–116 (V_3). This tube and tube (V_3) form a two-stage d-c amplifier. As the grid of tube (V_2) becomes sufficiently negative, there will be no plate current in tube (V_2) and no voltage across its plate load. Tube (V_3) will then have no grid bias. When the grid bias of tube (V_2) becomes zero (or positive with respect to its cathode), plate current flows through its plate load resistor (15–1). Tube (V_3) will then have a high negative bias.

c. As in the case of tube (V_2), when the grid of tube (V_3) becomes sufficiently negative, Tube VT–96 (V_4) will have no bias. When the grid voltage on tube (V_3) approaches zero, tube (V_4) will have a high

negative bias, and the plate current in one section will be cut off. When the grid voltage approaches zero, the plate current of tube (V_3) will cause a voltage to be developed across resistor (16) in such a direction that the upper end will be negative with respect to the lower end, which is connected to a resistor (27–2) (fig. 7) or (39) (fig. 8). This voltage is impressed directly across the grid and cathode of the left-hand section of tube (V_4) and acts as the control voltage for this tube.

13. OSCILLATOR (figs. 7 and 8). **a.** Tube (V_4) is a double-triode functioning as a tone oscillator (of the multivibrator type) at a frequency of approximately 800 cycles. This frequency is determined mainly by the values of the tank circuit made up of inductor (5) and capacitor (2–2). The feedback circuit, composed of capacitor (1) and resistor (17), also has some effect on the frequency. Any small voltage variation in the plate circuit of the right-hand section of tube (V_4) is fed to the grid of the left-hand section through capacitor (1) and resistor (17). This is amplified by the left-hand section and fed back to the grid circuit of the right-hand section through the capacitor (2–1). Thus energy is fed from each section of the tube to the other section in the proper phase, and oscillation takes place. In order to keep the wave shape of the signal from squaring, it is necessary to prevent too great a flow of voltage back to the grids. To do this, the plate loads of each section are center-tapped at the junction of resistors (19–1) and 19–3) and resistors (19–2) and (19–4). The a–c returns to the grids are brought to these junction points.

b. When the light source and tape reduce the left-hand grid voltage of tube (V_4) to zero, oscillation takes place. No light on tube (V_1) causes the grid voltage of tube (V_4) to be highly negative, which results in the plate current being cut off through the left-hand section of tube (V_4) so that there can be no oscillation.

c. When the main control switch is thrown to KEY, the grid of tube (V_3) is connected to ground through the key. When the key is open, the grid voltage of tube (V_3) is zero and the oscillator is inoperative. When the key is pressed, connecting the grid of tube (V_3) to ground, a high negative voltage appears on its grid and the tube (V_4) oscillates.

14. POWER AMPLIFIER (figs. 7 and 8). **a.** The 800-cycle voltage developed across the tank circuit is fed across resistor (20), the volume control. This voltage is impressed on the grid of the left-hand section of the double-triode, phase-inverter Tube VT–96 (V_5). The signal voltage is then amplified and appears across the plate load resistor (22–2); then, through its coupling capacitor, it is impressed on the grid of Tube VT–115 (V_7). At the same time, the grid resistor

for tube (V_7) acts as a voltage divider. The portion of the voltage developed across resistor (23) is fed to the right-hand grid of Tube VT–96 (V_5). The output from this half of tube (V_5) is fed to the grid of Tube VT–115 (V_6). This produces the necessary 180° phase difference between the signals appearing on the grid of tubes (V_6) and (V_7). The voltage divider, resistors (15–2) and (23), is properly proportioned to make these voltages equal in value. On Keyer TG–10–J (fig. 8) resistors (36–1) and (36–2), in series with the control grid of tubes (V_6) and (V_7), act as high-frequency chokes to prevent parasitic oscillations when glass tubes are used instead of metal tubes in the keyer.

b. The output voltage from tubes (V_6) and (V_7) appears across transformer (34). The low impedance secondary of this transformer has a resistor connected across the 15-ohm output winding, in order to keep tubes (V_6) and (V_7) partially loaded when external loads are removed from the keyer.

c. The rectifier circuit of Tube VT–244 (V_8) has a resistor (29) connected in series with the load which serves to limit the peak and surge currents to capacitor section (4–3). Resistor (30) is connected in series with inductor (6), in order to provide the proper voltage for the screen grids of the output tubes (V_6) and (V_7).

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Section IV

Maintenance

Caution: Read and carefully observe the precautions given in the safety notice at the front of this manual.

15. PREVENTIVE MAINTENANCE. a. Scheduled inspections. The operator should set up a regular preventive maintenance schedule covering the points listed below and any additional points needing regular attention. A check-up based on this schedule should be made daily, if the keyer is used daily, or at regular intervals, if the keyer is not used every day. This check-up will reduce repairs and delay.

NOTE. Do not abuse or handle roughly any of the controls or components on the front panel.

b. Inspection points. The check-up should include the following:

(1) See that the exciter lamp and dial lamp light.
(2) Check the fuse. If a blown fuse is replaced and the new fuse burns out, check for short circuits in the unit. *Never replace a fuse with one of higher rating.*
(3) Inspect all tubes to see if filaments light. For metal tubes, touch a moistened finger tip to the shield after the set has been on for a few minutes. The shield should be warm.
(4) Make a visual inspection of the unit.
(5) Inspect all plugs, cables, and connectors.
(6) Keep the equipment as clean and as free of dust as possible.
(7) See that all roller shafts, gears, and related parts are properly lubricated at all times. For detailed instructions on lubrication see paragraph 17.
(8) See that the light aperture is clean.
(9) See that the mirror lens is clean (par. 16a(1)).
(10) See that rollers and shaft collars are not so tight on the shafts that they bind, or so loose that they cause excessive wear.
(11) See that all collar and roller keys are tight.

16. SERVICING. a. Lens and mirror system. (1) Clean the exposed side of each lens (60) (figs. 3 and 4) daily with a soft cloth or cleansing tissue.

Caution: Do not use a tissue, cloth, or any material that contains dirt, grit, or any abrasive or the lens surface will be scratched.
(2) At least once a week, remove the mirror housing casting (62) (figs. 1 and 2), and clean the mirror lens.
(3) Remove the phototube cover (59) (figs. 1 and 2) once a week and clean the light aperture carefully with a piece of fine wire to remove any accumulation of grit or lint.
(4) The position of the lens and mirror housing is adjustable to permit positioning the light beam on the small aperture in the phototube cover (59) (figs. 1, 2, 5, and 6). By turning the lower screw (165) (figs. 5 and 6) on the housing, which is provided with a spring tension holding arrangement, the housing may be moved away from, or brought closer to the panel. Lateral adjustment of the lens and mirror housing is obtained by loosening the upper screw, moving the housing to the desired position, and retightening the screw.

b. Drive cone and roller. A supply of neoprene rings is included in the spare parts kit. To replace the rings—
(1) Release the setscrew in the collar.
(2) Remove the puller-shaft retaining collar (72) (fig. 4) as follows: grasp the tape-puller roller (79) (figs. 1 and 2) and pull the shaft forward. This releases the cone-driven roller assembly, which is keyed to the shaft.
(3) To remove and replace the neoprene ring on Keyer TG–10–(2), remove the nut and outer washer of the cone-driven roller assembly. After the shaft of Keyer TG–10–(1) has been pulled forward, the old neoprene ring can be rolled off its metal pulley and the new one installed.
(4) In reassembling, be sure to set up the retaining collar (72) (fig. 4) so that excess end play of the puller shaft is prevented; but be sure that this adjustment is not tight enough to cause binding.
(5) About once a month clean the neoprene ring (77) (figs. 3 and 4) and the driving cone (74) (fig. 4) with benzene and a soft cloth to remove any oily film which may have accumulated. *Do not use abrasives, such as sandpaper, on the driving cone.*

c. Puller roller. A supply of puller rollers (79) (figs. 1 and 2) is included in the spare parts group. To replace the rubber portion, remove the acorn nut on the front of the roller and take off the outer washer. Remove the rubber puller, install a new one, and reassemble.

d. Transformers. One spare transformer of each type required by Keyer TG–10–(&) is included in the spare parts group.

e. Amplifier. Figures 7 and 8 are circuit diagrams of the amplifier and oscillator. The same diagram is attached to the bottom plate of the chassis. Paragraphs 18, 19, and 20 give the necessary information for checking and servicing the amplifier.

f. Tubes. Tubes in the keyer may be checked in a standard tube tester. Replace all defective tubes.

g. Photoelectric cell. To replace the photoelectric cell (V_1) (figs. 7 and 8), first loosen the knurled nut (165) (figs. 5 and 6) under the protruding housing and remove the housing cover (59) (figs. 5 and 6). Replace tube and housing cover.

h. Exciter lamp. The exciter lamp (9) (figs. 3 and 4) contains two filaments. To change from one filament to the other, first remove the bulb from its socket and then reinsert it after turning it through 180° or halfway around. This will connect the spare filament. If both filaments are burned out, replace the bulb. If no spare exciter lamps are available, replace it with a standard 32–32 candlepower, No. 1000 automobile headlight bulb. To adjust the focus of the light beam, loosen the two screws holding the exciter lamp socket, move the lamp and socket to the optimum position, and retighten the two screws.

i. Fuse. To check the fuse located at the rear of the chassis, unscrew the red portion of the fuse holder (45) (figs. 3 and 4) with a screw driver. The fuse will come out with the screw cap. If it is defective, insert a new one. If fuses are not available from spare stock, the keyer may be fused with a standard 3AG automotive fuse having a rating of 3 amperes at 250 volts.

17. LUBRICATION CHART.

Reference number	Lubrication points	Lubricant	Quantity of lubricant	Service periods	Special instructions
42	Motor bearings	SAE 10 or medium mineral oil.	As required	1,000 hours operation or at 3-month intervals.	Remove motor assembly and saturate felt oil retainers.
71	Helical gear on motor assembly.	White petrolatum	As required	400 hours operation or at 1-month intervals.	
75 and 79	Cone shaft and tape-puller bearings.	SAE 10 or medium mineral oil.	One drop	400 hours operation or at 1-month intervals.	
78	Splined section of tape-puller shaft.	White petrolatum	As required	600 hours operation or at 2-month intervals.	
88	Speed control feed screw	White petrolatum	As required	600 hours operation or at 2-month intervals.	
92	Indicator dial shaft bearing.	SAE 10 or medium mineral oil.	One drop	600 hours	
96	Take-up reel shaft	SAE 10 or light mineral oil.	As required	400 hours or at 1-month intervals.	Disassemble and clean bearing surface every 1,500 hours.
85	Pressure roller	SAE 10 or light mineral oil.	As required	400 hours or at 1-month intervals.	Disassemble and clean bearing surfaces every 1,500 hours.
99	Tape guide rollers	SAE 10 or light mineral oil.	As required	400 hours or at 1-month intervals.	Disassemble and clean bearing surfaces every 1,500 hours.
103	Rewind	SAE 10 or light mineral oil.	As required	400 hours or at 1-month intervals.	

18. TROUBLE LOCATION CHART. a. TAPE position. Symptoms (1), (2), and (3) below apply when the amplifier, exciter lamp, or motor are completely dead. If the amplifier is apparently ON and the exciter lamp and motor operate, but no signal is received from the keyer, look for the remaining symptoms, b(1) to (11), inclusive, below. Tube (V_8) (figs. 7 and 8) will light and some heat will be radiated by the other tubes, especially tubes (V_6) (figs. 7 and 8) and (V_7) (figs. 7 and 8), if the amplifier is drawing power, even though it is not working properly.

Symptom	*Cause*
(1) Amplifier dead, exciter lamp OFF, motor not running.	No a-c line voltage. Open power lead. Poor plug (11) (figs. 3 and 4) contact. Burned-out fuse (par. 16i). Defective power switch (31) (figs. 5 and 6). Loose connection from power receptacle (11) (figs. 5 and 6) to fuse holder (45) (figs. 3 and 4), to switch (31) (figs. 5 and 6), to transformers (32) and (33) (figs. 5 and 6) and receptable (12) (figs. 5 and 6).
(2) Exciter lamp not lighted, motor runs, amplifier ON.	Burned out exciter lamp (9) (figs. 3 and 4). Loose connection or defective socket for exciter lamp (9) (figs. 3 and 4). Defective power switch (31) (figs. 5 and 6). Loose connection on power switch (31) (figs. 5 and 6). Defective exciter lamp transformer (32) (figs. 5 and 6). Loose connection from power switch (31) (figs. 5 and 6) to transformer (32) (figs. 5 and 6) to socket of exciter lamp (9) (figs. 3 and 4).
(3) Motor dead, exciter lamp and amplifier ON.	Defective motor receptacle (12) (figs. 5 and 6) or plug. Defective motor receptacle (12) (fig. 6) or plug (41) (fig. 4). Loose connection from power switch (31) to motor receptacle (12) (figs. 5 and 6). Loose connection from motor plug (41) (fig. 4) to switch (43) (fig. 2), to motor (42) (fig. 4) on Keyer TG–10–(2). Defective motor (42) (figs. 3 and 4).

b. KEY position—key terminals shorted. For check of the operation of the amplifier alone, it is easier to start with the switch set at KEY position, since this narrows the preliminary search to the

oscillator and power amplifier. These components are common to both KEY and TAPE operation. Test all tubes on a standard tube checker before starting on a circuit analysis.

Symptom	*Cause*
(1) No filament voltage.	Defective power transformer (33) (figs. 5 and 6).
	Loose connection from power transformer (33) (figs. 5 and 6) to tube sockets.
(2) No plate or screen voltage on tubes (V_6) and (V_7) (figs. 7 and 8).	Burned-out rectifier tube.
	Open resistor (29) (figs. 5 and 6).
	Open filter choke (6) (figs. 3 and 4) (no screen voltage).
	Shorted filter capacitor (4–3) (figs. 7 and 8) or (4–4) (figs. 7 and 8).
	Loose connection or open lead from rectifier tube (V_8) (figs. 7 and 8) to resistor (29) (figs. 5 and 6) to output transformer (34) (figs. 3 and 4), to plates of tubes (V_6) and (V_7) (figs. 7 and 8); or from resistor (29) (figs. 5 and 6) to filter choke (6) (figs. 3 and 4), to resistor (36) (on Keyer TG–10–J), to screens of tubes (V_6) and (V_7) (figs. 7 and 8).
	Open primary of output transformer (34) (figs. 3 and 4).
(3) High plate and screen voltage tubes (V_6) and (V_7) (figs. 7 and 8).	Open resistor (24) (fig. 11).
	Open lead or loose connection from resistor (24) (fig. 11) to tube socket.
(4) Low plate and screen voltage tubes (V_6) and (V_7) (figs. 7 and 8).	Shorted resistor (24) (fig. 11).
	Shorted capacitor (4–2) (figs. 7 and 8).
	Shorted grid resistor (15–2) or (15–3) (fig. 11).
	Shorted coupling capacitor (3–2) or (3–3) (fig. 11).
	Open lead or loose connection from resistor (15–2), (15–3), or (23) (fig. 11) to tube socket or ground.
(5) Low or no plate voltage tube (V_5) (figs. 7 and 8).	Defective or open resistor (22–1) or (22–2) (fig. 11).
	Defective or open resistor (23) (fig. 11).
	Defective resistor (21) (fig. 11).
	Loose connection or open lead from resistor (20) (figs. 5 and 6), (22–1), or (22–2) (fig. 11) to tube socket.

Symptom	*Cause*
(6) High plate voltage tube (V_5) (figs. 7 and 8).	Open resistor (21) (fig. 11).
	Loose connection or open lead from resistor (21) (fig. 11) to tube socket or ground.
(7) Low or no plate voltage tube (V_4) (figs. 7 and 8).	Defective or open resistor (19–1), (19–2), (19–3), or (19–4) (fig. 11).
	Defective resistor (28) (fig. 11).
(8) High plate voltage tube (V_4) (figs. 7 and 8).	Open resistor (18) (fig. 11).
	Loose connection or open lead from resistor (18) to tube socket or ground.
(9) No audio frequency output.	Headset plug not completely inserted in jack (8) (figs. 1 and 2).
	Defective headset, headset plug, or headset cord.
	Loose connections from transformer (34) (figs. 3 and 4) or jack (8) (figs. 1 and 2) to terminal strip (35) (figs. 3 and 4).
	Defective secondary on output transformer (34) (figs. 3 and 4).
	Shorted external leads from terminal strip (35) (figs. 3 and 4).
	Damaged capacitor (2–2) (figs. 5 and 6), (1) (fig. 11), or (3–1) (fig. 11).
	Defective or damaged resistor (16) or (17) (fig. 11).
	Defective or damaged oscillator choke (5) (figs. 3 and 4).
(10) A-c ripple in output.	Defective filter choke (6) (figs. 3 and 4).
	Defective filter capacitor (4–3), (4–4), (4–2), or (4–1) (figs. 7 and 8).
(11) Low audio frequency output.	Defective tube (V_4), (V_5), (V_6), or (V_7), (figs. 7 and 8).
	Defective output transformer (34) (figs. 3 and 4).
	Shorted external leads from terminal strip (35) (figs. 3 and 4).
	Shorted or damaged resistor (25) (figs. 7 and 8).
	Open or defective resistor (23) (fig. 11).
	Open or damaged capacitor (3–1), (3–2), or (3–3) (fig. 11).
	Loose connections from any of these parts.

c. TAPE position—tape operating. After the troubles indicated by symptoms (1) to (3) in a above and (1) to (11) inclusive in

b above have been corrected, check operation at TAPE as follows: satisfactory operation at KEY and no operation at TAPE limits the trouble to tubes (V_1), (V_2), and (V_3) (figs. 7 and 8), and their associated mechanical and electrical parts. Make these tests only after it has been definitely assured that the phototube aperture, lens and mirror, controls, etc., are set according to the operation instructions in paragraph 9. The point-to-point resistance check should indicate all probable defects.

Symptom	*Cause*
(1) No plate voltage tubes (V_2 and V_3) (figs. 7 and 8).	Shorted capacitor (4–1) (figs. 7 and 8).
	Open resistor (27–1) ((27–2) (fig. 11) on Keyer TG–10–(1)), (27) ((39) (fig. 11) on Keyer TG–10–(2)), ((26) (figs. 7 and 8), or (40) (fig. 8) (not on Keyer TG–10–(1)).
	Loose connection to tube socket.
(2) No keying with tape.	Open resistor (13–1) or (13–2) (figs. 7 and 8).
	Resistor (13–1) or (13–2) shorted to shield ground (figs. 7 and 8).
	Loose connection to tube socket.

19. POINT-TO-POINT D-C VOLTAGES. The tube socket pins from which the measurements shown in the following table are made are identified by numbers appearing on the bottom of the sockets. The readings are taken with line voltage of 115 volts; both bias controls at extreme right; volume control advanced one-half of its total rotation; main switch turned alternately from KEY to TAPE, as noted; photocell adjustable cover in normal operating position without paper tape or other subtsance interrupting light beam; and with nothing connected to OUTPUT terminals or KEY terminals. The location of the tubes from the bottom of the chassis is shown in figures 9 and 10 where they are identified by the type and tube number. The following readings should be checked with a 20,000-ohm-per-volt meter only.

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Tube		Plate		Filament		Cathode		Screen		Switch position	
No.	Type	Pins	Volts	Pins	Volts	Pins	Volts	Pins	Volts	Tape	Key
(V_1)	VT–252	4–GD*	42							X	
(V_1)	VT–252	4–GD	47								X
(V_2)	VT–116	8–5	0. 64	2–7	5. 0	5–GD	21	6–5	95	X	
(V_2)	VT–116	8–5	0	2–7	5. 0	5–GD	22	6–5	110		X
(V^3)	VT–116	8–5	60	2–7	6. 2	5–GD	60	6–5	63	X	
(V_3)	VT–116	8–5	2. 4	2–7	6. 2	5–GD	67	6–5	65		X
(V_4)	VT–96	8–3	88	2–7	6. 2	8–1	120			X	
(V_4)	VT–96	8–3	167	2–7	6. 2	8–1	132				X
(V_4)	VT–96	8–6	80	2–7	6. 2	8–1	120			X	
(V_4)	VT–96	8–6	75	2–7	6. 2	8–1	132				X
(V_5)	VT–96	8–3	145	2–7	6. 2	8–1	3. 6			X	
(V_5)	VT–96	8–3	162	2–7	6. 2	8–1	3. 9				X
(V_5)	VT–96	8–6	150	2–7	6. 2	8–1	3. 6			X	
(V_5)	VT–96	8–6	165	2–7	6. 2	8–1	3. 9				X
(V_6)	VT–115	8–3	370	2–7	6. 2	8–1	21	8–4	255	X	
(V_6)	VT–115	8–3	362	2–7	6. 2	8–1	23	8–4	275		X
(V_7)	VT–115	8–3	370	2–7	6. 2	8–1	21	8–4	255	X	
(V_7)	VT–115	8–3	362	2–7	6. 2	8–1	23	8–4	275		X
(V_8)	VT–244	Plate to plate	750	2–8	5. 0						
Exciter lamp					6. 3						

*GD=chassis.

20. POINT-TO-POINT RESISTANCES. a. Resistance in ohms from socket contacts to chassis. The tube socket pins from which the measurements shown in the following tables are made are identified by numbers appearing on the bottom of the sockets. The conditions for taking these measurements are that: the plug be disconnected from the power source, both bias controls at extreme left, the volume control be rotated to extreme right; and the main switch at TAPE. The location of the tubes from the bottom of the chassis is shown in figures 9 and 10 where they are identified by type and tube number.

TG–10–A, B, AND C

No.	Type	1	2	3	4	5	6	7	8
(V_1)	VT–252		40 meg.		5, 700				
(V_2)	VT–116	0	5, 700	1, 000	40 meg.	1, 000	275, 000	5, 700	275, 000
(V_3)	VT–116	0	5, 700	5, 700	275, 000	5, 700	78, 400	5, 700	78, 400
(V_4)	VT–96	0	5, 700	70, 400	78, 400	6, 400	70, 400	5, 700	6, 870
(V_5)	VT–96	0	5, 700	116, 400	500, 000	9, 100	116, 400	5, 700	1, 500
(V_6)	VT–115	0	5, 700	20, 400	16, 400	280, 000	(1)	5, 700	250
(V_7)	VT–115	0	5, 700	20, 400	16, 400	270, 000	(1)	5, 700	250

TG–10–D, F, G, H, AND J

(V_1)	VT–252		40 meg.		3, 700				
(V_2)	VT–116	0	3, 700	1, 200	40 meg.	1, 200	7, 700	3, 700	280, 000
(V_3)	VT–116	0	3, 700	3, 700	280, 000	3, 700	7, 700	3, 700	78, 000
(V_4)	VT–96	0	3, 700	70. 000	78, 000	8, 200	72, 000	3, 700	8, 200
(V_5)	VT–96	0	3, 700	115, 000	500, 000	9, 100	115, 000	3, 700	1, 500
(V_6)	VT–115	0	3, 700	22, 000	18, 000	300, 000	270, 000	3, 700	250
(V_7)	VT–115	0	3, 700	22, 000	18, 000	300, 000	270. 000	3, 700	250

[1] Not measured.

b. Resistance from resistor and capacitor mounting card terminals to chassis. The terminals of the resistor and capacitor mounting card (38), from which measurements of resistance to chassis are made, are identified by color coding (figs. 9 and 10). Resistance measurements from these terminals to chassis are indicated below in the order in which the terminals appear when the bottom of the keyer is viewed with the front toward the observer (except on Keyer TG–10–(1). The conditions for taking these measurements are that the plug be disconnected from the power source, both bias controls be at extreme left, the volume control be rotated to extreme right, and the main switch at TAPE.

Wire color code	Resistance to chassis (ohms)	Wire color code	Resistance to chassis (ohms)
Black	0	Yellow	250
Green	300, 000		110, 000
Brown	9, 100		0
Blue	115, 000	Green	300, 000
Red	115, 000	Red	18, 000
Yellow	1, 500		0
Green	8, 200	Blue	550, 000
Blue	70, 000		45, 000
Brown	72, 000		18, 000
Red	78, 000		480, 000
Yellow	8, 200	Green	7, 800
Brown	3, 700	Yellow	1, 250
Green	280, 000		3, 700

21. INSTRUCTIONS FOR FUNGIPROOFING AND MOISTUREPROOFING. The instructions contained herein are a guide for processing Keyer TG–10–(&).

a. Unscrew and remove the six screws and washers holding the front panel to the case.

b. Turn the unit over on its side and remove the three screws, nuts, and washers holding the chassis to the bottom of the case.

c. Turn the unit to original position and slide the chassis out of the case.

d. With a clean cloth, remove all dirt, dust, and rust or corrosion, from the case and chassis.

e. Remove the following tubes from chassis:

2 Tubes VT–116	1 Photocell (RCA 923).
2 Tubes VT–96	1 Tube 5U4G.
2 Tubes VT–115	1 Exciter lamp (Mazda No. 1000).

f. With masking tape, cover—

(1) Nine tube sockets (top).
(2) Lens of exciter lamp, rear and front of panel.
(3) Around base of motor plug and socket.
(4) All vent holes around top, sides, and bottom of motor.
(5) Oilholes and shafts in all gears and bearings.
(6) Neoprene ring for drive roller.
(7) Battery connector lugs (at rear).

g. Turn the chassis on its side and remove the four screws holding the panel base to the chassis. Remove the panel.

h. Untie the lacing from the cable form and allow the wires to hang loose.

i. With masking tape, cover the jack contact and jack collar.

j. Loosen the knurled nut at the base of the photocell tube cover and remove cover. Mask the socket with tape.

k. The unit is now ready for baking. Place the components in a heating apparatus and bake at a temperature of 160° F. *Do not exceed this temperature.* Bake the unit for approximately 3 hours. Watch for indications of melted wax; if this becomes evident, lower the baking temperature, adding 1 hour to the baking time for each 10° F. drop.

l. After baking, remove the components of the unit from heating apparatus and apply varnish to all parts and exposed metal with a paint brush or spray. Follow the instructions provided with the kit.

m. After the varnish has been applied, replace the unit in the heating apparatus and allow it to remain there for approximately 30 minutes until the varnish has dried.

n. Remove the unit from the heating apparatus and repeat the application of varnish. Replace it in the heating apparatus. Shut off heat and allow unit to cool for approximately 12 hours. When the unit has returned to normal temperature and varnish is absolutely dry (not tacky), remove all masking tape.

o. Clean off any excess varnish on those portions where it will impede electrical continuity or mechanical action. Extreme caution should be taken when varnishing around moving parts, as varnish, when dry, will impede the mechanical motion.

p. Upon completion of baking, remove the unit and spray three or four coats of varnish on exposed elements and surfaces. Do not spray front panel of unit. Spray the inside of the case. When varnish has dried, remove masking tape.

q. Replace all parts removed; oil all shafts, gears, and bearings. Check the unit when assembled and mark it MFP____(date),_____ to show it has been fungiproofed and moistureproofed.

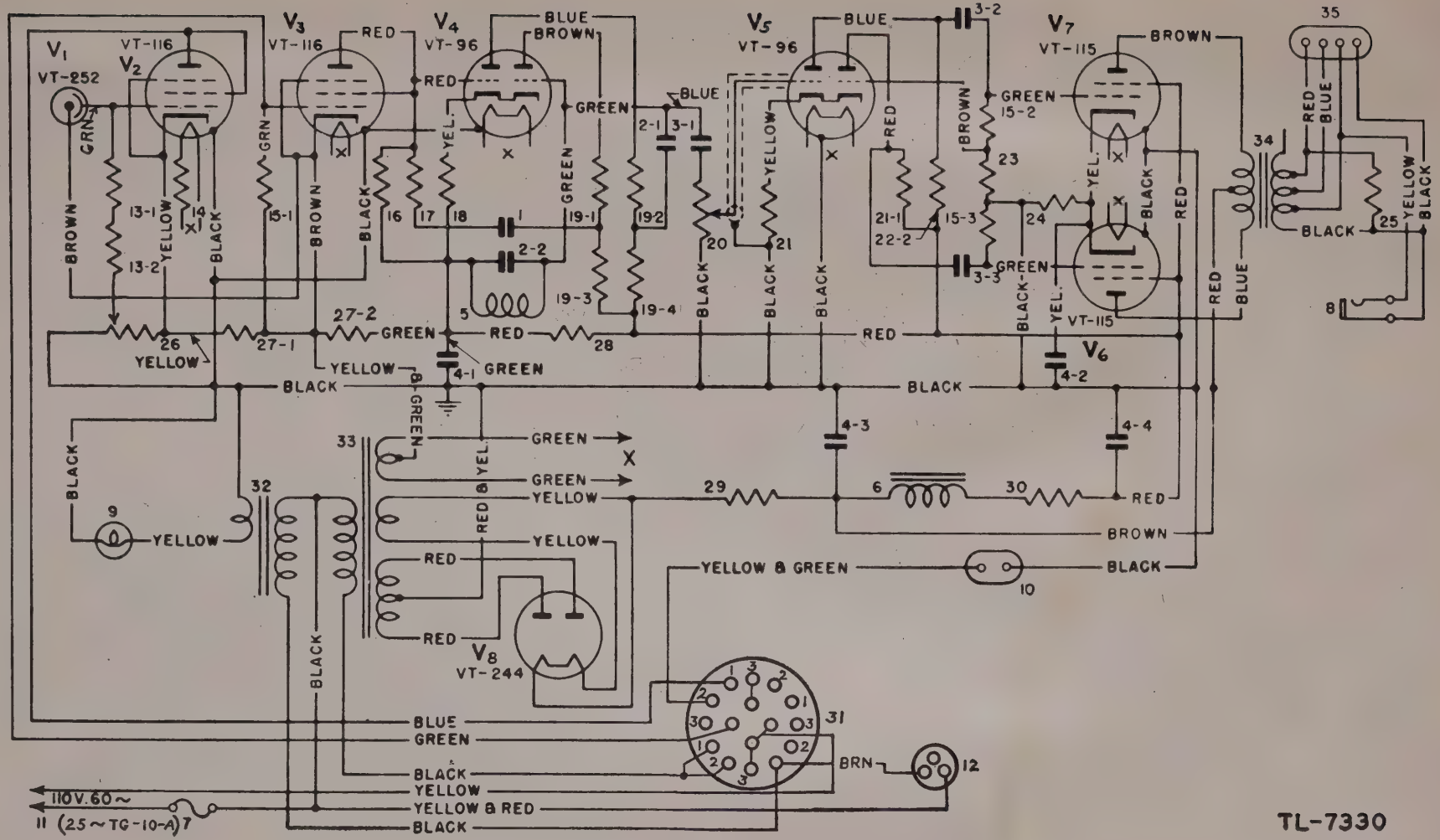


FIGURE 7. *Keyer TG–10–(1), schematic diagram.*

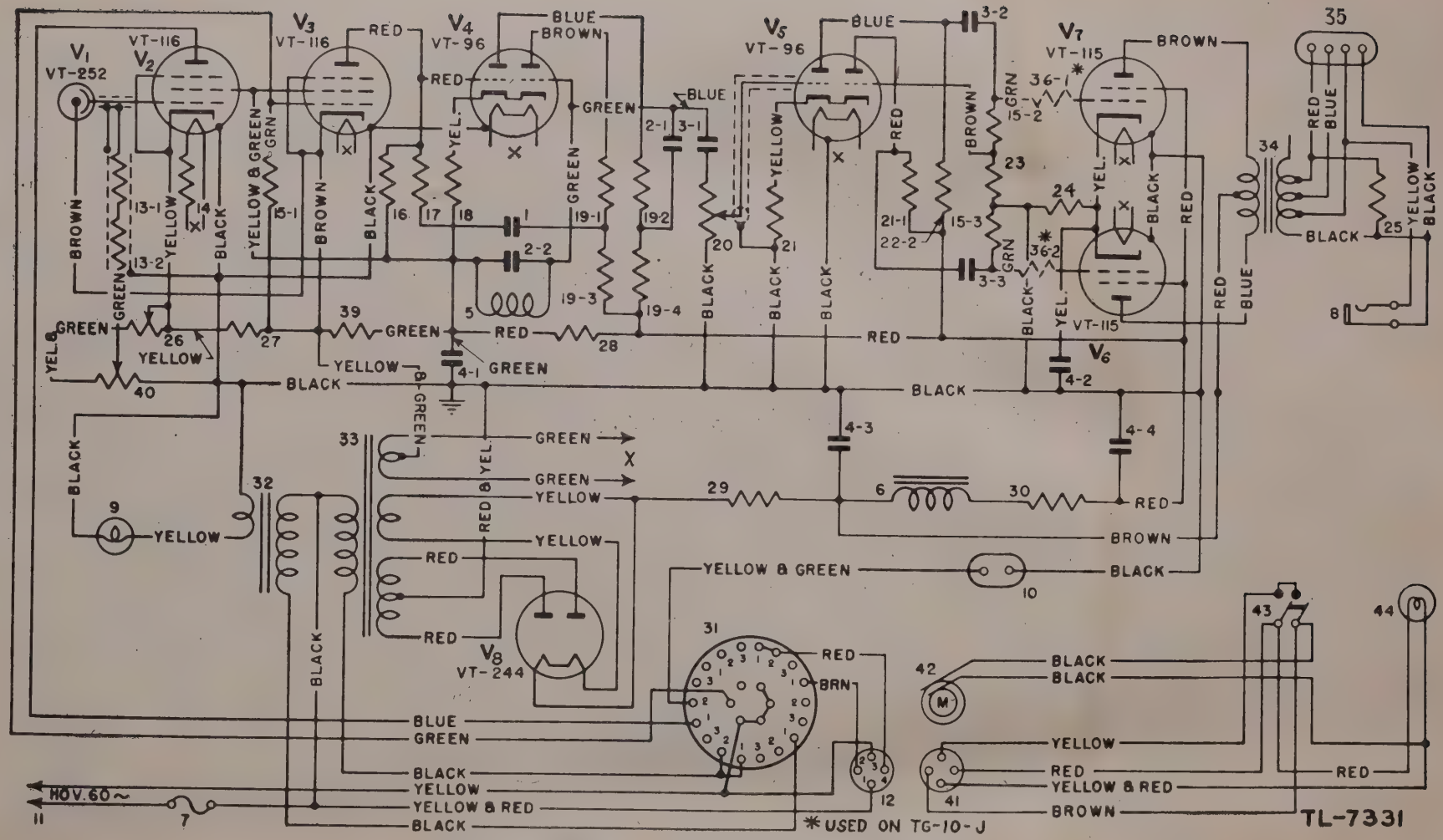


FIGURE 8. *Keyer TG–10–(2), schematic diagram.*

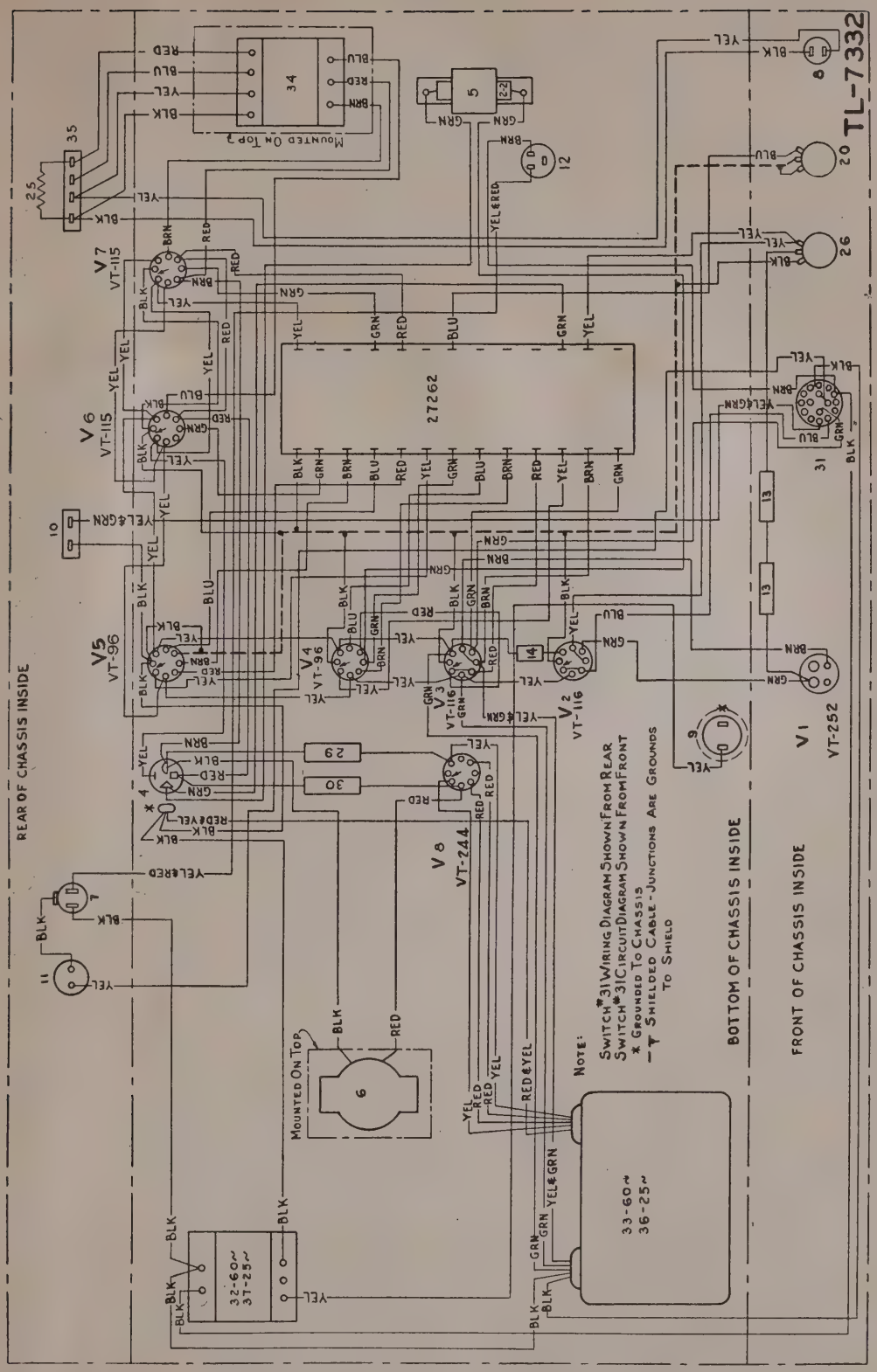


FIGURE 9. *Keyer TG–10–(1), wiring diagram.*

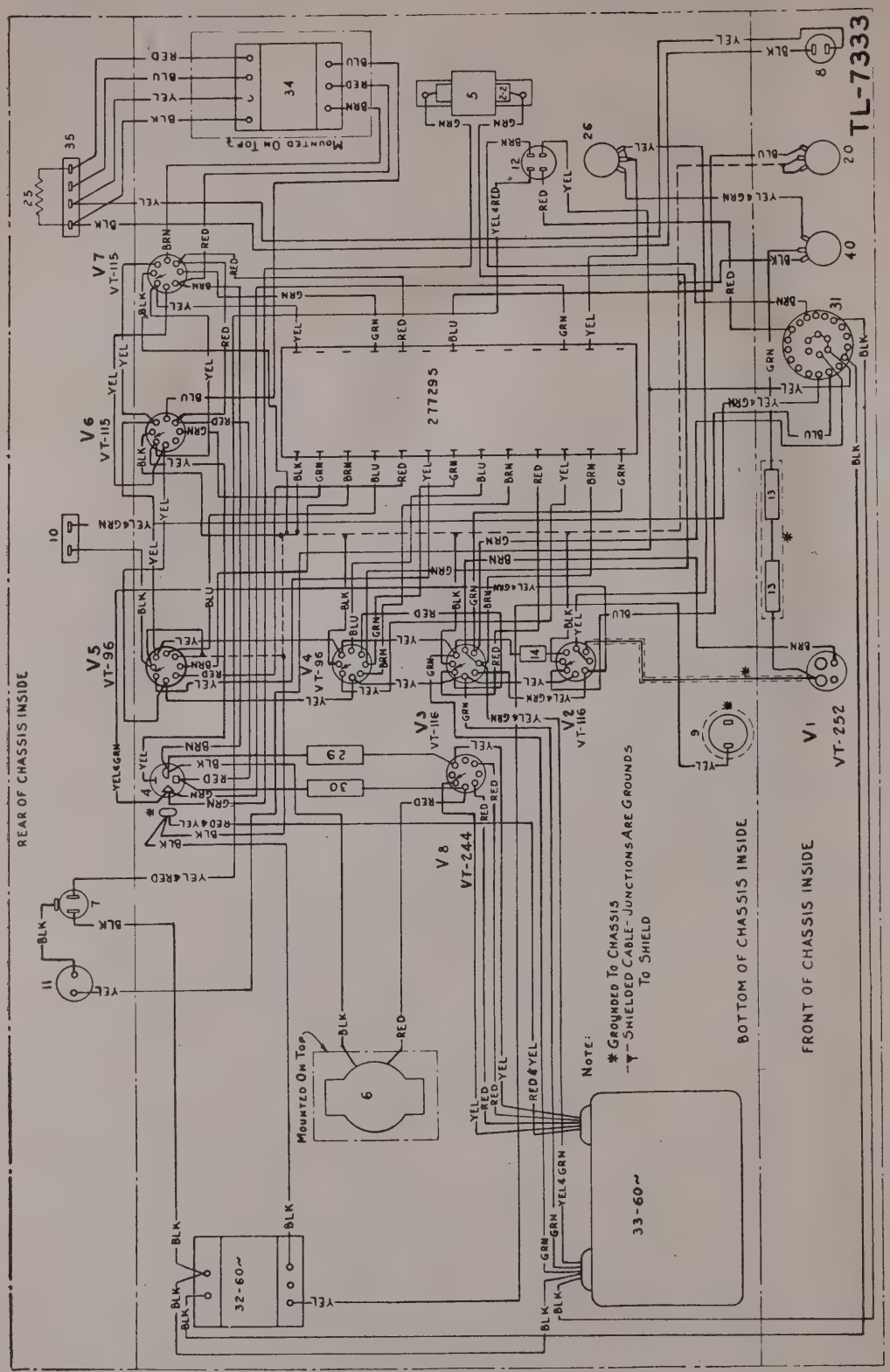
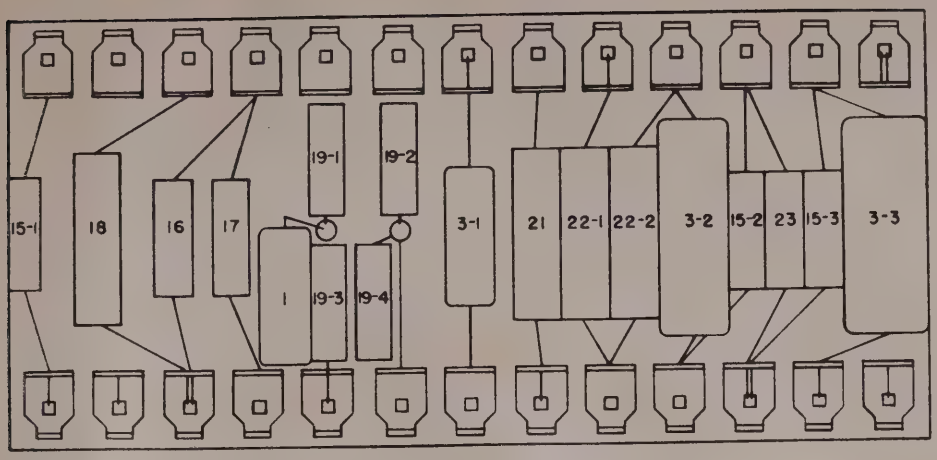
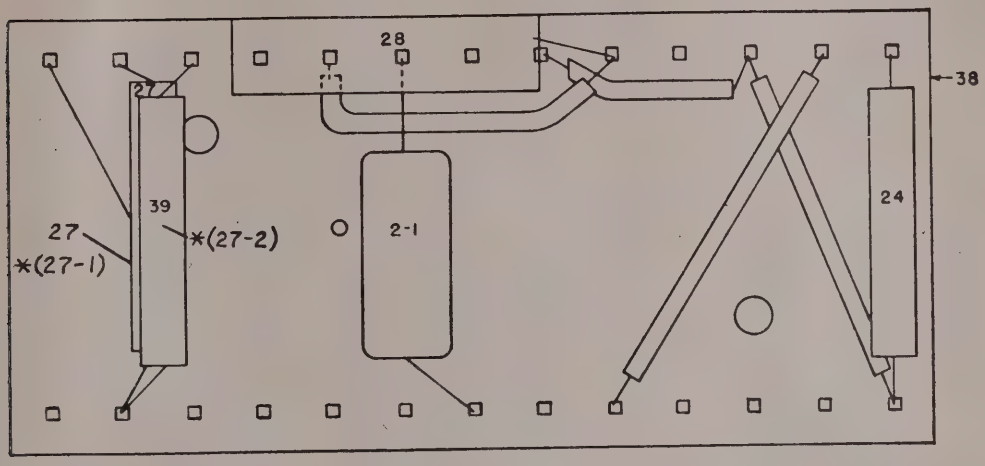


FIGURE 10. *Keyer TG–10–(2), wiring diagram.*





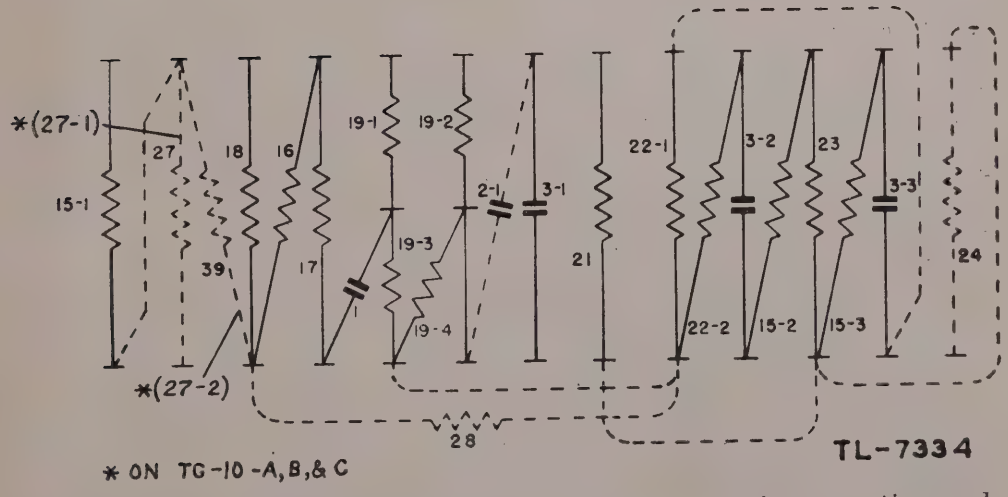


FIGURE 11. *Schematic diagram of resistor and capacitor mounting card.*

Section V

Supplementary Data

22. TABLE OF REPLACEABLE PARTS.

Reference No.	Signal Corps stock No.	Name	Description	Function	Manufacturer	Manufacturer's drawing No.
1 ABCD [1] FGHJ	3D9500–74	Capacitor	0.0005-μf, $\pm$10 percent, 300-v d-c working, #1468.	Oscillator feedback	A [2]	27300
2–1 ABCD FGHJ	3DA100–47	Capacitor	0.1-μf, $\pm$40 percent—10 percent, 200-v d-c working, paper, tubular.	Oscillator feedback		27303
2–2 ABCD FGHJ	3DA100–47	Capacitor	0.1-μf, + 40 percent—10 percent, 200-v d-c working, paper, tubular.	Oscillator tank		27303
3–1 ABCD FGHJ	3DA10–149	Capacitor	0.01-μf, +40 percent—10 percent, 300-v d-c working paper, #71–516–E.	1st audio grid coupling.	Signal Corps specifications.	27301
3–2, 3 ABCD FGHJ	3DA10–143	Capacitor	0.01μf, +40 percent—10 percent, 600-v d-c working, paper, tubular, #27302.	2d audio grid coupling.	SP	27302

4–1, 2, 3, 4 ABCD FGHJ	3DB10–24	Capacitor	Four-section aluminum can, 10-10-10-10-μf, +40 percent—10 per percent, 450-v d-c working, dry, electrolytic, #FPQ-434.	Filter	MA	27304
5 ABCD FGHJ	3C2513	Coil	Tank, 450-mh, air core, #T–46005	Oscillator tank	TH	27293
6 ABCD FGHJ	3C316–22	Coil	6 h at 80 ma, iron core, tropical treatment and special lead lengths, #T–46008.	Filter choke	TH	27294
7 ABCD FGHJ	3Z2603. 2	Fuse	3-amp, 250-v, glass tube, type #1043	Line	LF	27323
8 ABCD FGHJ	2Z5599	Jack	Monitor, 2-contact, insulated, open circuit, 3½″ long, #1, including extruded fiber washer #203, bakelite washer #212, brass washer #225, ⅜–32 nut #232.	Monitor	M–Y	[3]
9 ABCD FGHJ	6Z6806	Lamp	6- to 8-v, 32-cp (2-filament), bayonet base, Mazda.	Phototube exciter	GE	27284
10 ABCD FGHJ	2Z9463. 1	Terminal	2-contact, fiber-mounted, screw type, #2–50.	Key	HJB	27335
11 ABCD FGHJ	2Z7138. 1	Receptacle	2-pole, flush, male, 1¼″ diameter, #61M10.	A–c supply	HM	27334

[1] Letters indicate models to which part applies.
[2] See par. 23 for meanings of letters.
[3] Jack #27331, Ext. washer #27736, Bak. washer #27737, Br. washer #27738, Nut #27142.

22. TABLE OF REPLACEABLE PARTS—Continued.

Reference No.	Signal Corps stock No.	Name	Description	Function	Manufacturer	Manufacturer's drawing No.
12 ABC	2Z8684–4	Socket	Female, 4-contact miniature polarized chassis mounting, ⅝″ diameter, #S4S.	Motor socket		27332
12 DFGHJ	2Z8684	Socket	Female, #S4S	Motor socket	AM	27717
13–1, 2 ABCD FGHJ	3Z6820	Resistor	20-megohm, ±10 percent, ½-w, carbon, #BT–½.	Phototube load	IRC	27350
14 ABCD FGHJ	3Z5994–4	Resistor	4.7-ohm, ±10 percent, 1-w, wirewound, #BW–1.	Series filament, 1st d-c amplifier.	IRC	27358
15–1 ABCD FGHJ	3Z6727	Resistor	270,000-ohm, ±10 percent, ½-w, carbon, #BT–½.	2d d-c grid	IRC	27351
15–2, 3 ABCD FGHJ	3Z6727	Resistor	270,000-ohm, ±10 percent, ½-w, carbon, #BT–½.	2d audio grid resistors.	IRC	27351
16 ABCD FGHJ	3Z6668	Resistor	68,000-ohm, ±10 percent, ½-w, carbon, #BT–½.	2d d-c plate load	IRC	27352
17 ABCD FGHJ	3Z6739–1	Resistor	390,000-ohm, ±10 percent, ½-w, carbon, #BT–½.	Oscillator feedback	IRC	27353
18 ABCD FGHJ	3Z6047–8	Resistor	470-ohm, ±10 percent, 1-w, carbon, #BW–1.	Cathode bias, oscillator.	IRC	27359

19–1, 2, 3, 4 ABCD FGHJ	3Z6627–1	Resistor	27,000-ohm, ±10 percent, ½-w, carbon #BT–½.	Oscillator plate load resistors.	IRC	27354
20 ABCD FGHJ	2Z7296–500 M. 2.	Potentiometer	500,000-ohm, taper C wire-wound, with moisture seal and special shaft, 1¼″ diameter, #1218 or #1240.	Volume control	IRC	27311
21 ABCD FGHJ	3Z6150–35	Resistor	1,500-ohm, ±10 percent, 1-w, wire-wound, #BW–1.	Cathode bias, 1st audio.	IRC	27360
22–1 ABCD FGHJ	3Z4608	Resistor RS–208.	100,000-ohm, ±10 percent 1-w, carbon, #BT–1.	Plate load, 1st audio	IRC	27356
23 ABCD FGHJ	3Z6591	Resistor	9, 100-ohm, ±10%, ½-w, carbon, #BT–½.	Inverter grid, 1st audio.	IRC	27355
24 ABCD	3Z6025–20	Resistor	250-ohm, ±5 percent, 10-w, wire-wound, #10–K.	Cathode bias, 2d audio.	SP	27361
FGHJ	3Z6010–55	Resistor	100-ohm, ±5 percent, 10-w, wire-wound, #10–K.	Output load	SP	27362
25 ABCD FGHJ						
26 ABC	2Z7296–IM	Potentiometer	Volume control, 500,000-ohm, #1211	Phototube bias	IRC	27310
26 DFGHJ	2Z7296–IM. 2	Potentiometer	1,000-ohm, 2-w, lineal taper, wire-wound, with moisture seal and special shaft, 1¼″ diameter, #2224.	Phototube bias	IRC	27734
27 ABC	3Z6470–10	Resistor	4,700-ohm, 2-w, #BT–2	Voltage divider	IRC	27357
27 DFGHJ	3Z6250–2	Resistor	2,500-ohm, ±10 percent, 1-w, wire-wound, #BT–1.	Voltage divider	IRC	27730

22. TABLE OF REPLACEABLE PARTS—Continued.

Reference No.	Signal Corps stock No.	Name	Description	Function	Manufacturer	Manufacturer's drawing No.
28 ABCD FGHJ	3Z6610–72_ ____	Resistor_____	10,000-ohm, ±5 percent, 10-w, wire-wound, #10–K.	Voltage divider_____	SP_____	27363
29 ABCD FGHJ	3Z6020–29_____	Resistor_____	200-ohm, ±5 percent, 10-w, wire-wound, #10–K.	Voltage divider_____	SP_____	27364
30 ABCD FGHJ	3Z6400–23_____	Resistor_____	4,000-ohm, ±5 percent, 10-w, wire-wound, #10–K.	Voltage divider_____	SP_____	27365
31 ABC	3Z9827.34_____	Rotary switch._	4-pole, 3-position, #3143J_____	Power and selector_.	MA_____	27330
31 DFGHJ	3Z9827.32_____	Switch_____	6-circuit, 3 contacts per circuit, shorting with special shaft length, $1\frac{11}{16}$" diameter of base, #363J.	Power and selector_	M–Y_____	27732
32 A	2Z9617.1_____	Transformer___	110-v, 25-cycle, #T–46006_____	Exciter lamp filament.	TH_____	27116
32 BCD FGHJ	2Z9717–1_____	Transformer___	Filament, 110-v, 60-cycle, (pri. 115-v, 47 ma; sec. 6.3-v, 6 amp.) with tropical treatment, #T–46003.	Exciter lamp filament.	TH_____	27292
33 A	2Z9619_____	Transformer___	110-v, 25-cycle, #T-46002 (mod. to 25-cycle).	Power_____	TH_____	27117
33 BCD FGHJ	2Z9717–2_____	Transformer___	Power, 110-v, 60-cycle; 375–O–375–v, 150-ma; 5-v, 4-amp; 6.3-v, 5-amp; tropical treatment and special leads, #T–46002.	Power_____	TH_____	2729(

34 ABCD FGHJ	2Z9632.25	Transformer	Output pri. 8,000-ohm C. T. sec. 0-, 4-, 8-, and 15-ohm, tropical treatment with special leads, #T–46004.	Output	TH	27291
35 ABCD FGHJ	2Z9404.2	Terminal	4-contact, fiber-mounted, screw type, #4–50.	Output	HBJ	27336
36–1, 2 J	3Z6025–3	Resistor	250-ohm, ±10 percent, ½-w, carbon, 3/16″ diameter, 9/16″ long, #BT–½.	Output tubes, parasitic oscillation suppressor.	IRC	27748P
38 ABCD FGHJ	4A1200A/406	Mounting card	Bakelite card including soldering lugs and mounting studs, special.	Resistor and capacitor mounting.		27406
39 DFGHJ	3Z6400–3	Resistor	4,000-ohm, ±10 percent, 2-w, #BT–2	Voltage divider	IRC	27731
40 DFGHJ	2Z7287.2	Potentiometer	200-ohm, 2-w, linear taper, wirewound, with moisture seal and special shaft length, 1¼″ diameter, #2181.	Vernier bias	IRC	27735
41 ABC	2Z7138.2	Plug	Male, 3-contact	Motor connection	AM	27333
41 DFGHJ	2Z7234–6	Plug	4-contact, polarized, shielded, miniature, #MP4S.	Motor connection	AM	27592
42 A	3H3000–1.1	Motor	110-v, 25-cycle, #CX–21325	Tape drive	GI	27115
42 BC	3H3000–1	Motor	110-v, 60-cycle, #CX–21325	Tape drive	GI	27270
42 DFGHJ	3H3000–3	Motor	115-v, 60-cycle, 0.65-amp, shaded pole, phonograph-recording motor, GI type, RX with special shaft, #23028.	Tape drive	GI	27511

22. TABLE OF REPLACEABLE PARTS—Continued.

Reference No.	Signal Corps stock No.	Name	Description	Function	Manufacturer	Manufacturer's drawing No.
43 DFGHJ	3Z9858–5	Switch	Motor, double-pole, single-throw toggle.	Motor and switch	BUD	27590
44 ABCD FGHJ	2Z5886	Lamp	120-v, 4-w, candelabra base, miniature bulb, Mazda #1000.	Dial light	GE	27596
45 ABCD FGHJ	3Z3275	Fuse post	Black bakelite, 2⅛″ long, ½″ mounting hole, includes post, extractor, nut, and washer, #1075.	Fuse mounting	LF	(4)
46 DFGHJ	4A1200D/719	Resistor assembly.	Includes two 20-megohm, ½-w resistors (13–1) and (13–2), brass shield tube 2½″ long, brass shield tube 1⅜″ long, plastic insulating beads, special.	Phototube plate resistor assembly.		27719
48 ABCD FGHJ	6Z8358	Socket	Metal-flanged, double-contact, bayonet type, with solder terminals, #12.	Exciter lamp	M	27321
49 ABCD FGHJ	228762.2	Socket	Tube, 8-prong, octal, 8-contact, retainer-ring mounting, mica-filled, for 1/32″ stock, #SS–8.	Vacuum tubes	AM	27319
50 ABCD FGHJ	2Z8659–4	Socket	4-contact, retainer-ring mounting, Steatite, #SS4.	Phototube	AM	27320
51 DFGHJ	2Z5988–16	Socket	Candelabra type, insulated slotted bracket, bent down, #414L–CH.	Dial lamp	D	27595
54 DFGHJ	4A1200D/716	Retainer ring	1 5/16″ OD x ¾″ ID x 3/32″ steel washer, 2 tapped holes #6–32, special.	Exciter lamp socket retainer ring.		27716

59 ABC	4A1200A/233	Phototube adjuster assembly.		Phototube aperture adjustment.		27233
59 DFGHJ	4A1200D/710	Phototube adjuster assembly.	Drawn brass shell, 1⅜″ diameter, includes clamping screw and nut, special.	Phototube aperture adjustment.		27710
60 ABCD FGHJ	4A1200A/222	Lens	Molded glass, 1.17″ diameter, special.	Optical system		27222
62 ABC	4A1200A/224	Mirror housing assembly.	Molded bakelite, special	Mirror housing		27224
62 DFGHJ	4A1200D/580	Mirror housing assembly.		Mirror housing		27580
63 ABCD FGHJ	4A1200A/225	Mirror	1¾″ x 1½″ x ⅛″ sheet glass, silvered one side, special.	Optical system		27225
66 DFGHJ	4A1200D/625	Gasket	⅜″ x 2⅛″ x ⅛″ sheet sponge rubber, special.	Dust seal, mirror housing.		27625
69 ABC	4A1200A/111	Bracket	Motor	Motor mounting		27111
69 DFGHJ	4A1200D/512	Bracket	Motor, special	Motor mounting		27512
70 DFGHJ	4A1200D/513	Bracket	2.33″ x 1.62″ x 0.62″, 3/32″ sheet steel; includes pressed-in bearings, special.	Cone mounting		27513
71 DFGHJ	4A1200D/514	Helical gear	42 teeth, left-hand helix, canvas base, bakelite, steel hub, special.	Motor speed reducer		27514
72 DFGHJ	4A1200D/579	Collar	Steel, ¼″ ID, ½″ OD; 0.19″ thick with #4–40 setscrew hole, special.	Shaft retainer		27579

[4] Post #27322, extractor #27746, nut #27724, washer #27747

22. TABLE OF REPLACEABLE PARTS—Continued.

Reference No.	Signal Corps stock No.	Name	Description	Function	Manufacturer	Manufacturer's drawing No.
73 DFGHJ	4A1200D/520	Rocker and bearing assembly.	3.22″ x 2.75″ x 1.00″, 3/32″ sheet steel; includes pressed-in bearings, special.	Tape puller shaft		27520
74 ABC	4A1200A/112	Cone	Driving	Variable speed drive		27112
74 DFGHJ	4A1200D/515	Cone	Driving, black bakelite molded with steel inserts, 2¼″ diameter large end, 90° angle of cone special.	Variable speed drive		27515
75 DFGHJ	4A1200D/516	Shaft	Driving cone ¼″ diameter, steel, 2.89″ long, special.	Cone		27516
77 ABC	4A1200A/126	Neoprene ring	#48	Tire, cone-driven roller.	AIR	27126
77 DFGHJ	4A1200D/527	Neoprene ring	Molded, 1″ ID, ¼″ diameter cord, #1815.	Tire, cone-driven roller.	AIR	27527
78 DFGHJ	4A1200D/537	Shaft	Tape drive roll shaft assembly, ¼″ diameter steel, 5.09″ long, includes 3/8″ diameter steel sleeve, special.	Tape-puller shaft		27537
79 ABC	4A1200A/120	Tape-puller roller.		Tape puller		27120
79 DFGHJ	4A1200D/532	Tape-puller roller.	Molded, amber gum rubber, 1″ OD, ¼″ hole, ½″ thick, #1161.	Tape puller	AIR	27532
81 ABCD FGHJ	4A1200A/137	Rocker-arm support assembly.	Cast iron, 1.84″ long, includes rocker pivot shaft, special.	Rocker support		27137
82 DFGHJ	4A1200D/536	Spring	Rocker tension, ¼″ OD, 0.032″ music wire, 1.80″ closed length, special.	Contact pressure variable speed drives.		27536

83 DFGHJ	4A1200D/548	Bearing	½″ diameter x 21/64″ long, brass, special.	Pressure roller pivot bearing.		27548
84 DFGHJ	4A1200D/540	Assembly	Pressure roller, 1¾″ x ½″ x 1/16″ sheet steel, includes arm shaft and pressure roller stud, special.	Pressure roller mounting.		27540
85 ABC	4A1200A/185	Roller	Pressure assembly	Tape contact pressure.		27185
85 DFGHJ	4A1200D/546	Roller	Pressure, special	Tape contact pressure.		27546
86 DFGHJ	4A1200D/545	Cam assembly	1″ diameter x 1/16″, sheet steel, assembled to hub, special.	Rocker lifting		27545
87 DFGHJ	4A1200D/550	Bracket assembly.	Speed control, includes indicator dial bearing, special.	Support, speed control mechanism.		27550
88 DFGHJ	4A1200D/553	Feed screw		Speed control		27553
89 DFGHJ	4A1200D/622	Collar	Take-up reel shaft, ⅜″ OD, 3/16″ hole; 0.19″ thick, steel, #4–40 setscrew hole, special.	Retainer, feed screw and reel shaft.		27622
90 ABC	4A1200A/165	Yoke	Hub assembly	Retainer, cone-driven roller.		27165
90 DFGHJ	4A1200D/565	Yoke	Speed control assembly	Retainer, cone-driven roller.		27565
92 DFGHJ	4A1200D/557	Shaft	Speed indicator dial shaft, 3/16″ diameter, steel, 1.28″ long, includes brass dial gear, 32-pitch; 14 teeth, 3/16″ face, Boston Gear Works #G–165, special.	Indicator dial shaft		27557
94 ABC	4A1200A/246	Speed control dial assembly.	1½″ diameter, molded plastic with steel inserts, special.	Tape speed indicator.		27246

22. TABLE OF REPLACEABLE PARTS—Continued.

Reference No.	Signal Corps stock No.	Name	Description	Function	Manufacturer	Manufacturers' drawing No.
94 DFGHJ	4A1200D/566	Speed control dial assembly.		Tape speed indicator.		27566
96 ABC	4A1200A/200	Shaft	Take-up, reel shaft assembly	Support take-up reel		27200
96 DFGHJ	4A1200D/570	Shaft	Take-up, reel shaft assembly, 5/16" square, steel, 2.19" long, includes reel retaining ball and 5/16" diameter brass spring, belt-driven pulley, special.	Support, take-up reel		27570
97 ABC	4A1200A/198	Bushing	Take-up reel	Panel-bearing; reel shaft.		27198
97 DFGHJ	4A1200D/572	Bearing	1/2" diameter brass; 3/4" long; 3/16" hole, special.	Panel-bearing; reel shaft.		27572
98 ABC	4A1200A/203	Belt		Take-up reel drive		27203
98 DFGHJ	4A1200D/573	Belt	0.11" diameter coil spring, 0.016" music wire; 11 3/4" closed length, no initial tension, special.	Take-up reel drive		27573
99 ABC	4A1200A/184	Roller		Tape guide		27184
103 ABCD FGHJ	4A1200A/209	Rewind assembly	Rewind assembly equivalent to #748 KM with special materials and finish, special.	Tape rewind		27209
104 ABCD FGHJ	4A1200A/213	Spring	Rewind bracket, 3/8" wide x 0.020" formed spring steel, special.	Rewind bracket		27213

105 ABCD FGHJ	2Z5838	Knob	Black bakelite, pointer, ¼″ shaft, #S–292.	Vernier bias control	EBY	27337
106 ABC	2Z5822	Knob	Speed indicator #S–308–3–BB	Speed control knob	K–K	27338
106 DFGHJ	2Z5822–7	Knob	Black, molded bakelite, for ¼″ shaft; ¾″ diameter knurled rim, #S–292–16.	Speed control knob	K–K	27552
110 ABC	4A1200A/102	Bracket	Amplifier, chassis, special	Amplifier bracket, right-hand.		27102–RH
111 ABC	4A1200A/102	Bracket	Amplifier chassis, special	Amplifier bracket, left-hand.		27102–LH
112 ABC	2Z1573.7	Cabinet	10½″ x 21″ x 15″, #DL–128	Keyer cabinet	P–M	27104
112 DFGHJ	2Z1573.7	Cabinet	10½″ x 21″ x 13½″ steel cabinet, #DL–128.	Keyer cabinet	P–M	27601
116 DFGHJ	4A1200D/600	Cabinet assembly.	Cabinet with hardware assembled, special.	Keyer cabinet		27600
123 ABCD FGHJ	8A3240	Reel	16-mm, 400′ capacity film reel, sheet steel, black enamel finish, standard.	Tape	B&H	27190
124 ABC	3A3590–1	Power cord		A-c power line		27275
124 DFGHJ	3E3590	Cord	2-conductor, rubber-covered, 2-pole male plug one end, 2-pole female plug other end, 8′ long, special.	A-c power line		27610
125 ABCD FGHJ	2T96	Tube VT–96	Class B twin triode metal, vacuum, #6N7.	Oscillator and 1st audio tubes.		27280
126 ABCD FGHJ	2T115	Tube VT–115	Beam power amplifier metal, vacuum, #6L6.	Push-pull output		27281

22. TABLE OF REPLACEABLE PARTS—Continued.

Reference No.	Signal Corps stock No.	Name	Description	Function	Manufacturer	Manufacturer's drawing No.
127 ABCD FGHJ	2T116	Tube VT–116	Triple grid detector amplifier, metal, vacuum, #6SJ7.	1st and 2d d-c amplifier tubes.		27282
128 ABCD FGHJ	2T244	Tube VT–244	Full-wave, high-vacuum rectifier, glass, #5U4G.	Rectifier tube		27283
129 ABCD FGHJ	2T252	Tube VT–252	Phototube, #923	Phototube	RCA	27285
156 ABCD FGHJ	6L7944	Screw	#4, 3/16″ drive, roundhead, nickel-plated, #2.	Name plates to panel.	PK	27383
158 ABCD FGHJ	6L7942	Screw	#2, 3/16″ drive, roundhead, nickel-plated, #2.	Dial window to panel; dial to support.	PK	27385
164 ABCD FGHJ	6L3710–32.40	Nut	#10–32 hexagon cap, brass, black, nickel-plated.	Puller retainer		27345
165 ABCD FGHJ	6L3106–32.40	Nut	#6–32 knurled, brass, black, nickel-plated.	Photo cover clamp		27349
166 ABCD FGHJ	6L3506–32.1	Nut	Hexagon 3/8–32	Cone-driven roller and panel bearings.		27142
167 DFGHJ	6L3106–32.8	Nut	#6–32 cap nut, 5/8″ long, 5/16″ hexagon, steel, special.	Pressure roller retainer.		27549

178 DFGHJ	6L52016	Washer	1⅜″ OD x ⅜″ ID x 3/32″ thick steel, special.	Spacer, cone-driven roller.		27528
179 DFGHJ	6L52015	Washer	1 1/16″ OD x ⅜″ ID x 1/16″ thick steel, special.	Flange, cone-driven roller.		27529
187 ABCD FGHJ	6L3901–1	Pin	⅛″ x ½″ groove pin, parkerized, #4	Rewind hinge stop	GP	27342
188 ABC	6L3902–3	Pin	3/32″ x ⅜″ groove pin, parkerized, #2.	Stop for pressure roller arm.	GP	27340
189 DFGHJ	6L3902–4	Pin	3/32″ x ¼″, groove pin, parkerized, #2.	Key for cone-driven roller.	GP	27522
190 DFGHJ	6L3904–5	Pin	1/16″ x ⅜″ groove pin, parkerized, #5.	Shaft to rocker; support bracket.	GP	27343
194 ABCD FGHJ	6R15600	Screw driver	Phillips, #2	Service tool	ASC	27398
300 ABC	4A1200A/122	Assembly	Driving shaft	Tape-puller shaft		27122
301 ABC	4A1200A/123	Pulley	Spring belt, drives tape puller	Take-up drive		27123
302 ABC	4A1200A/127	Assembly	Motor-driven pulley assembly	Take-up drive		27127
303 ABC	4A1200A/132	Spring	Rocker-arm pressure	Rocker-arm tension		27132
304 ABCD FGHJ	4A1200A/134	Support	Rocker-arm support	Supports rocker arm.		27134
305 ABCD FGHJ	4A1200A/135	Shaft	Rocker-arm support shaft	Rocker-arm support shaft.		27135
306 ABC	4A1200A/136	Assembly	Rocker-arm assembly	Rocker support		27136

22. TABLE OF REPLACEABLE PARTS—Continued.

Reference No.	Signal Corps stock No.	Name	Description	Function	Manufacturer	Manufacturers drawing No.
307 ABC	4A1200A/141	Bushing	Speed control bushing	Speed control bushing.		27141
308 ABC	4A1200A/143	Shaft and gear assembly.	Speed control gear and shaft	Speed control		27143
309 ABC	4A1200A/144	Gear	Bevel, pinion, #G–486	Speed control	BGW	27144
310 ABC	4A1200A/147	Gear	Bevel, #G–486	Speed control	BGW	27147
311 ABC	4A1200A/153	Bevel gear and bracket assembly.		Speed control		27153
312 ABC	4A1200A/164	Assembly	Slide rod and flange			27164
313 ABC	4A1200A/177	Spring	Pressure roller spring	Pressure roller tension.		27177
314 ABC	4A1200A/189	Support	Take-up shaft support	Supports take-up shaft.		27189
315 ABC	4A1200A/218	Assembly	Take-up drive bracket assembly	Supports take-up drive.		27218
316 ABCD FGH	4A1200A/260	Card	Bakelite, natural paper base			27260
317 ABC	6L3901–2	Groove pin	1/8″ diameter, 5/8″ long, #4		G–P	27341
318 ABC	6L3902–1	Groove pin	1/32″ diameter, 5/8″ long, #5		G–P	27344

319 ABCD FGHJ	6R55499	Wrench	Allen setscrew, #4	Remove and replace setscrews.		27396
320 ABCD FGHJ	6R55498	Wrench	Allen setscrew, #5, #6	Remove and replace setscrews.		27397
321 DFGHJ	4A1200D/521	Rocker		Tape-puller shaft		27521
322 DFGHJ	4A1200D/525	Assembly	Cone-driven roller assembly	Variable speed driver.		27525
323 DFGHJ	4A1200D/530	Assembly	Tape-puller shaft assembly	Tape puller		27530
324 DFGHJ	4A1200D/559	Gear	Indicator dial #G–165		BGW	27559
325 DFGHJ	4A1200D/597	Assembly	Indicator dial, assembly			27597
326 DFGHJ	4A1200D/642	Bearing, bronze	Bronze bearing			27642
327 DFGHJ	4A1200D/729	Mounting card	Resistor and capacitor mounting card, complete.	Holds resistors and capacitors.		27729

23. NAMES AND ADDRESSES OF MANUFACTURERS.

A	Aerovox Corp., New Bedford, Mass.
AIR	Atlantic India Rubber Works, Inc., Chicago, Ill.
AM	American Phenolic Corp., Chicago, Ill.
ASC	American Screw Co., Providence, R. I.
BGW	Boston Gear Works, Inc., New York, N. Y.
B&H	Bell & Howell Co., Chicago, Ill.
BUD	Bud Radio, Inc., Cleveland, Ohio.
D	Drake Electric Works, Inc., New York, N. Y.
EBY	Hugh H. Eby, Inc., Philadelphia, Pa.
GE	General Electric Co., Cleveland, Ohio.
GI	General Industries Corp., Elyria, Ohio.
G-P	Groove Pin Corp., Union City, N. J.
HBJ	Howard B. Jones, Inc., Chicago, Ill.
IRC	International Resistance Co., Philadelphia, Pa.
K-K	Kurz-Kasch, Inc., Dayton, Ohio.
LF	Littlefuse, Inc., Chicago, Ill.
M	Frank W. Morse Co., New York, N. Y.
MA	P. R. Mallory, Inc., Indianapolis, Ind.
M-Y	Mallory-Yaxley Co., Indianapolis, Ind.
P-K	Parker-Kalon Corp., New York, N. Y.
P-M	Par-Metal Products Corp., Long Island City, N. Y.
RCA	RCA Mfg. Company, Harrison, N. J.
SP	Sprague Specialties, North Adams, Mass.
TH	Thordarson Electric Manufacturing Co., Chicago, Ill.